

Fiscal Year 2009

Annual Progress Report

Reported by Joseph F. McKeon, Colonel, MC



United States Army Aeromedical Research Laboratory

February 2010

Approved for public release, distribution unlimited.

**U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012**

REPORT DOCUMENTATION PAGE
*Form Approved
OMB No. 0704-0188*

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1. REPORT DATE (DD-MM-YYYY)				2. REPORT TYPE	3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE				5a. CONTRACT NUMBER		
				5b. GRANT NUMBER		
				5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S)				5d. PROJECT NUMBER		
				5e. TASK NUMBER		
				5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)					8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)					10. SPONSOR/MONITOR'S ACRONYM(S)	
					11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT						
13. SUPPLEMENTARY NOTES						
14. ABSTRACT						
15. SUBJECT TERMS						
16. SECURITY CLASSIFICATION OF:		17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON		
a. REPORT	b. ABSTRACT	c. THIS PAGE				
				19b. TELEPHONE NUMBER (Include area code)		

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Background

The United States Army Aeromedical Research Laboratory (USAARL) was originally established as the United States Army Aeromedical Research Unit (USAARU) in October 1962. As envisioned by Major General Spurgeon Neel, U.S. Army, the unit's mission was to provide direct aviation medical research support to all Army aviation and airborne activities, and to provide a central aeromedical research and reference library. Technical evaluation of aircraft and personnel equipment, aeromedical in-flight observations, and field problems analysis reported by other aviation agencies were part of the unit's early research program.

In 1969, USAARU was redesignated a Laboratory. Construction began on a new vivarium, and a year later, the Helicopter In-flight Monitoring System (HIMS), an airborne system capable of simultaneously measuring pilot and helicopter performance, was designed, built, and installed aboard the Laboratory's JUH-1J research helicopter. Lighting systems and paint schemes for collision avoidance were being addressed.

In May 1978, ground was broken for a new laboratory facility, with completion in March 1981. During the 1980s, USAARL scientists and support staff became increasingly involved in field studies throughout the Army in assessing hazards of military systems and operations, and biomedical means of enhancing Soldier selection, performance, and protection.

In 1990, USAARL was honored with the Department of Defense Award for Excellence. For its support and contributions to Desert Shield/Desert Storm, USAARL was awarded the Army Superior Unit Award in 1992.

In April 2004, USAARL was dedicated in memory of the "Father of Army Aviation Medicine," Major General Neel, for his integral role in the development of the principles of aeromedical evacuation of battlefield casualties.

Today, laboratory and field studies continue on the ground and in helicopter flight in those research disciplines unique to USAARL – vision and visual enhancement/protection, auditory injury/protection, impact injury/protection, jolt effects, crew stress/workload, and physiological life support. A JUH-60A aircraft and an NUH-60 flight simulator with specialized cockpit environmental controls help researchers with their flight performance investigations. Physicians, engineers, and safety experts work together to understand human injuries and damage to personal protective equipment from a crash. Researchers analyze and correct design and operational deficiencies in flight helmets, crashworthy seating, restraint systems, and develop criteria for future Warfighter systems.

This report presents an overview of USAARL activities during fiscal year 2009 (FY09), identifies current areas of research, and gives a brief description of the research programs being conducted.

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USAARL Mission and Vision

The USAARL's mission is to preserve and enhance the health, safety, combat effectiveness, and survivability of the U.S. Army Warfighter.

Our vision is to function as the Department of Defense Center of Excellence for mounted Soldier operational medical research. Special focus areas include:

- Prevention and reduction of neurosensory injury
 - Crash injury protection, survival, novel restraints, seating systems
 - Helmet design, fit, performance, helmet-mounted devices (HMD)
 - Visual displays and eye protection
 - Auditory displays and hearing protection
- Fitness for duty research for wounded warriors
 - Soldier performance after neurosensory injury (eyes, hearing, central nervous system)
 - Return-to-Duty criteria and strategies
 - Soldier performance in degraded operations (night, noise, fatigue)
- Test & evaluation of medical equipment for medical evacuation (MEDEVAC) environment

Through research, the USAARL supports the U.S. Army Medical Department's mission to "conserve the fighting strength."

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From the Commander

The United States Army Aeromedical Research Laboratory is proud to present this summary of achievements for FY09. USAARL continued to make significant contributions to preserving and enhancing the health, safety, combat effectiveness, and survivability of the Warfighter. Our researchers demonstrated their extraordinary agility in adapting to the constantly changing demands involved in protecting our Soldiers from an adaptive and tenacious enemy. USAARL established new, exciting and relevant collaborative partnerships with the Veterans Administration, other AMEDD facilities, and academia.

The Warfighter Performance and Health Division was extraordinarily productive in 2009. Completing two studies involving in-flight evaluations of pilot and passenger subjects, WPHD researchers concluded data collection on motion sickness among Unmanned Aerial Vehicle operators during flight as well as studying modafinil and dextroamphetamine in fatigued aviators in a full-motion flight simulator and in our JUH-60 Black Hawk helicopter. Additionally, WPHD completed a pre-deployment risk assessment on more than 500 3rd Infantry Division Soldiers, and will conduct post-deployment assessments upon their return.



During FY09, the Sensory Research Division's Acoustics Research Branch and the Warfighter Protection Division's Injury Biomechanics Branch continued their research on blast and traumatic brain injury through their collaboration with a multi-disciplinary team of Army and industry engineers, Army audiologists, and Navy cognitive psychologists to better understand the impact of blast exposure on U.S. Marine Corps breachers. Additionally, acoustics researchers initiated a study on the treatment of tinnitus, one of the leading causes of Veterans Administration disability claims, and continued their research (with the help of WPHD colleagues) on the noise-immune stethoscope, which will allow evaluation of patients during air evacuation.

The Airworthiness Certification and Evaluation Branch and the Aviation Life Support Equipment Retrieval Program continued to provide relevant contributions to protecting aircrew and patients during flight. The ALSERP team participated in several U.S. Army Combat Readiness/Safety Center investigations, providing timely and relevant input regarding restraint systems and crash-worthy seating. Additionally, work continued on cockpit airbags in the OH-58D Kiowa Warrior. The ACE team's evaluation and airworthiness certification requirements of critical patient movement items ensures safe interaction among medical equipment, patients, crew, and aircraft and directly support the Warfighter during aeromedical inter/intra-theater transport.

USAARL enjoyed great success on the E-7 promotion board, with a 75% selection rate. In addition, one of our non-commissioned officers (NCOs) was selected for, and attended, Officer Candidate School at Fort Benning, GA. We were also very well represented at the MRMC Soldier and NCO of the year competitions.

Finally, I would like to recognize some of our lab's 'unsung heroes.' While the mission of the lab is unarguably research, and the metrics that bring 'glory' center on publications and presentations, I could not be prouder of our support staff. We have made remarkable strides this year in human protection, in property accountability and logistics, and programs that take care of our Soldiers and civilian workforce. We have invested in civilian and Soldier physical fitness, with remarkable, measureable successes. We are poised to adopt newly mandated accounting and business practices (GFEBS), and continue to improve our Balanced Scorecard.

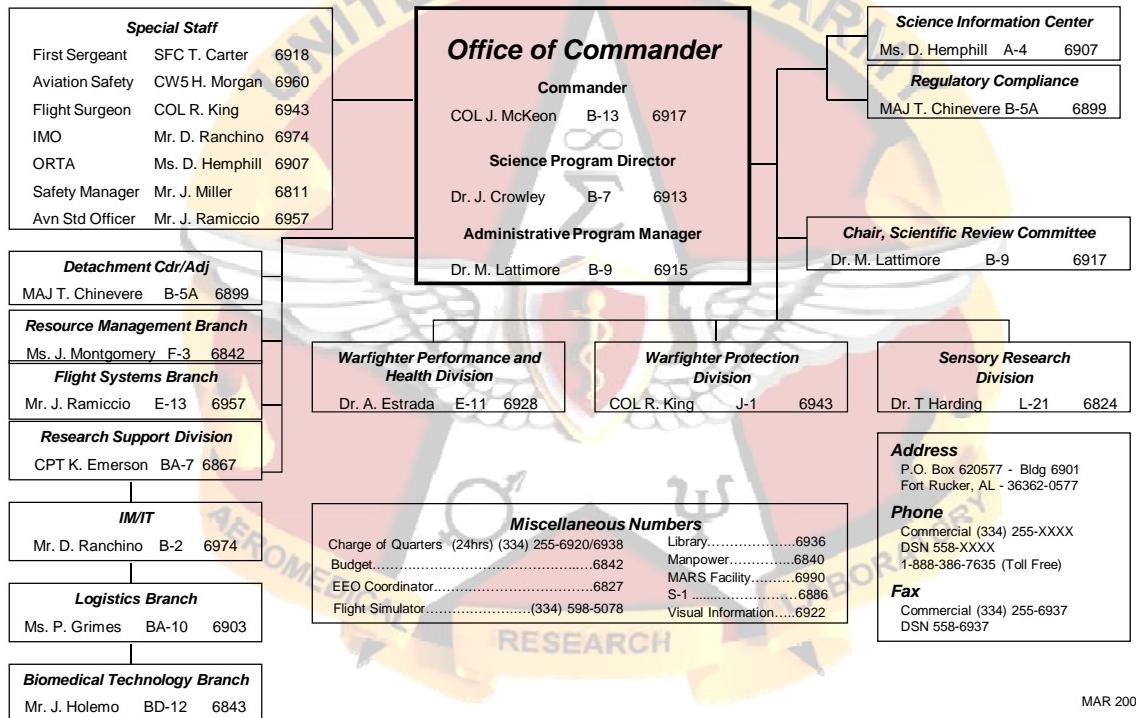
USAARL remains dedicated to supporting the U.S. Army Medical Department's mission to "conserve the fighting strength." We are proud of the work we accomplished to support the combat Warfighter and to train future military leaders. During FY10, we look forward to continued success in furthering research to protect Soldiers and will continue to dedicate our efforts to this continuing mission.

JOSEPH F. MCKEON
Colonel, Medical Corps
Commanding

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USAARL Organizational Chart

United States Army Aeromedical Research Laboratory
Fort Rucker, Alabama 36362-0577



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Scientific Programs

Warfighter Performance and Health Division

The Warfighter Performance and Health Division (WPHD) is comprised of two branches: the Aeromedical Factors Branch (AFB) and the Cognitive Assessment and Diagnostics Branch (CADB). Together these branches maintain a unique capability in basic and applied research relating to the modern Warfighter. During FY09, the research objectives of WPHD were to develop and document effective means of optimizing the performance of military personnel subjected to stressors such as spatial disorientation; disrupted sleep, work, and rest cycles; high cognitive workloads; and sustained operations. The research also included current and anticipated medical issues related to Warfighter injury prevention and reduction; psychological health and resilience, including traumatic brain injuries (TBI), post concussion syndrome (PCS), return-to-duty (RTD)/fitness-for-duty (FFD) issues, and physiological health. General scientific disciplines included aviation medicine, biomedical engineering, human factors, systemic and neurosensory physiology, and research psychology. Within this heterogeneous framework, the WPHD defined the biomedical impact of prototype and developmental military equipment in terms of individual tolerance and performance effectiveness; assessed emerging technologies in all of the above research fields; and translated these research results into useable, relevant recommendations to the field. The WPHD developed, maintained, and actively integrated technology transfer between other Department of Defense (DoD) laboratories and agencies, the civilian scientific sector, and allied countries.

In FY09, the WPHD staff was composed of both military and civilian employees. There were 10 investigators on staff (two M.D., five Ph.D., and three master's-level) with varying specialty areas including physiology, neurophysiology, neuropsychology, cognitive psychology, educational leadership, and human factors. The division staff was complemented by a project manager, research technicians, student contractors, and Soldiers skilled in medically-related fields. Division research included the use of a Black Hawk helicopter, flight simulator, micro-flight simulator, multi-axis ride simulator (MARS), tactile systems, cognitive assessment software tools, and an engagement skills weapons trainer.

Aeromedical Factors Branch

The AFB mission is to support the Warfighter by conducting cutting edge research to attenuate and mitigate operational stressors. During FY09, the research mission focused on the following areas: crew/operator endurance and sustainment (aviation and ground vehicles), situational awareness, motion sickness prevention, and advanced medical diagnostic tools. The AFB objectively and subjectively evaluated strategies to ameliorate the performance decrements and safety issues associated with fatigue and motion sickness through pharmacologic and non-pharmacologic intervention. Ongoing research in emerging tactile technologies and visual displays pursued solutions for spatial disorientation and loss of situational awareness

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experienced during helicopter flight operations in areas of limited visibility/contrast (e.g., “brownout” landings, hovering over snow/desert/water). In addition, new medical devices designed for use in high noise environments and novel equipment designed to aid the rehabilitation of wounded Soldiers were developed, tested, and evaluated for their clinical efficacy.

In FY09, AFB projects included the following:

A Comparison of the Efficacy of Modafinil and Dextroamphetamine as Alertness Promoting Agents in Aviators Performing Extended Operations

The objective of this study was to determine the side effects and degree to which low doses of modafinil and dextroamphetamine sustain alertness, performance, cognition, vigilance, judgment, mood, and decision-making throughout 40 hours of continuous wakefulness.

Aerial Command and Control of Unmanned Aircraft Systems

The primary objective of this project was to evaluate what aeromedical effects could impair the performance of airborne Unmanned Aircraft Systems (UAS) controllers when UAS are teamed with manned helicopters.

Effects of Ketamine and Morphine on the Performance of Warrior Skill Tasks

The goals of this study were to compare the ability to perform warrior tasks during ketamine and morphine analgesia and to identify potential utility of ketamine as a battlefield analgesic.

Motion Sickness Prevention by Stroboscopic Environment during Military Transportation

The objective of this study was to evaluate the effectiveness of 4-hertz (Hz) and 8-Hz stroboscopic environments in reducing visually-induced motion sickness during military transport.

The Effects of Spatial Disorientation on Working Memory and Mathematical Processing

The aim of this study was to examine the effects of spatial disorientation on aviators' cognitive processing.

Noise Immune Stethoscope

The efficacy of the Noise Immune Stethoscope (NIS) was tested in an animal model of thoracic injury and in a high noise environment (running helicopter) using a human source.

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Tactile Cuing for Rehabilitation following Traumatic Brain Injury

The goals of this study were to develop more sensitive measure(s) of balance control assessment and to demonstrate efficacy of a tactile cueing device as a tool to enhance balance training in patients with TBI.

Tactile Situation Awareness System

The objective of this study was to develop capabilities that provide non-visual, intuitive orientation and targeting information to the Warfighter to complement existing situation awareness systems and ensure that awareness of the “big picture” is maintained.

A Comparison of Accident Classification Systems for Fratricide Incidents during the Global War on Terror

The aim of this study was to classify the causes of fratricide incidents from 11 September 2001 to 31 March 2008 using the Fratricide Causal Analysis Schema (FCAS) and then compare FCAS classification to the results of the Human Factors Analysis and Classification System (HFACS) using the same set of fratricide incidents.

Cognitive Assessment and Diagnostics Branch

The mission of the CADB is to enhance the Warfighter’s performance through psychological and physiological health. Today’s combat operations in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) have created unique conditions that can have deleterious effects on the cognitive and emotional well-being of our Warfighter. During FY09, the CADB investigated the effects of TBI, sleep deprivation, substance use/misuse (licit and illicit), pre-morbid psychopathology, individual differences, and combat experiences on neuropsychological functioning and psychological health. Clarifying the contribution of specific variables precedes accurate diagnosis, assessment, and the development of efficacious treatments for both TBI and other combat-related psychopathology such as Post Traumatic Stress Disorder (PTSD). It is the goal of CADB to contribute to the proficiency and long-term stability, health and psychological well-being of the Warfighter.

The FY09, CADB projects included the following:

Assessment of Traumatic Brain Injury and Post Traumatic Stress Disorder

The objective of this study was to assess changes in behavior, cognition, and motivation of Soldiers with chronic symptoms from mild traumatic brain injury (mTBI)/PTSD. This investigation explored the relationships between neuroimaging, neurobehavioral, biological, and psychological measures. It is anticipated that research findings will contribute to RTD standards.

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Cognition-enhancing Drugs and their Appropriateness for Aviation and Ground Troops: A Meta-analysis

The goal of this study was to critically review and conduct a meta-analysis of the existing literature in order to identify cognition-enhancing drugs that may be suited for use in ground and aviation troops.

The Effect of Sleep Deprivation on Assessment of Causality, Correlation Detection, Illusory Correlation, and Performance on an Engagement Skills Trainer Task in Soldiers

The objective of this study was to evaluate accuracy on a series of causal judgment tasks and the Engagement Skills Trainer 2000 after a period of sleep deprivation and recovery sleep.

Effects of Selective Serotonin Reuptake Inhibitors on Cognition and Sleep

This study focused on assessing the effects of selective serotonin reuptake inhibitors (SSRI) on the behavior, cognition, motivation, and daytime wakefulness of Soldiers being treated for combat operational stress. The investigation explored the relationship between measures of neurocognitive performance, sleep latency and wakefulness, and sleep quality and quantity.

Risky Behavior and Attitudes about Risk in Soldiers Pre- and Post-deployment

The primary objective of this study was to assess risk propensity in Soldiers pre- and post-deployment. A secondary goal was to assess risk propensity and actual risk behaviors in Soldiers post-deployment; comparisons between those with PTSD, TBI, and poly-traumas.

Sleep Disturbances and U.S. Marine Corps Breacher Crewmen

This study evaluated the sleep patterns (i.e., quantity and quality of sleep) and cognitive functions of U.S. Marine Corps (USMC) breacher crewmen students and instructors before, during, and after training.

Brain Imaging of Learning, Memory and Emotion

The aim of this study is to investigate the role of various cortical regions in regulating emotional responses to aversive stimuli with use of function magnetic resonance imaging (fMRI). This project is in collaboration with the University of Alabama at Birmingham (UAB).

Long-chain Polyunsaturated Fatty Acid Status and Cognitive Performance

The goals of this research were to assess changes in behavior, cognition, and motivation of Soldiers with chronic symptoms from mTBI/PTSD and to explore the relationship between neuroimaging, neurobehavioral, biological, and psychological measures.

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Assessment of Acute Concussion in a Combat Environment (Iraq): Concurrent, Validity, Sensitivity, and Specificity of the Automated Neuropsychological Assessment Metrics.

The aim of this study was to test the validity of the Automated Neuropsychological Assessment Metrics (ANAM) for use in-theater for assessment of neuro-cognitive functioning following a concussion.

Warfighter Protection Division

The USAARL Warfighter Protection Division (WPD) is comprised of three branches, namely the Operational Survival Analysis Branch (OSAB), the Injury Biomechanics Branch (IBB), and the Airworthiness Certification and Evaluation (ACE) Branch. WPD's overall vision is to focus on injury prevention including primary protection in the identification of health hazards, secondary protection in the development of standards for better protective equipment, and tertiary protection in the advancement of mitigating factors in the post-injury phase. The WPD mission is "*to conduct research on and develop standards for Warfighter injury mechanisms, human tolerance levels, injury risk mitigation technologies and health hazards present in the full spectrum of Army operational and training environments including aviation and ground operations, MEDEVAC platforms, combat vehicles and weapons systems.*"

Operational Survival Analysis Branch

The OSAB's research efforts focus on primary protection in the identification of health hazards. The OSAB functions within the framework of the Joint Trauma and Prevention of Injury in Combat Program (JTAPIC). The JTAPIC program is administered by the U.S. Army Medical Research and Materiel Command (USAMRMC) and encompasses multiple organizations as partners; the USAARL contribution focuses on data procurement, analysis, and synthesis. During the past year, the USAARL conducted a detailed analysis of vehicle incidents (to include enemy actions and accidents) and personnel injuries.

The U.S. Army continues to face challenges regarding quantifying the performance of protective systems (including personal protective equipment [PPE] and vehicle-mounted safety systems) provided to combat Soldiers. Current U.S. Army military trauma databases, although able to answer myriad questions regarding trauma care, provide virtually no information regarding the circumstances of wounding or the use of protective equipment – lacking even such basic details as to whether the protective system was in use when the injury occurred. Gaps include the lack of data describing the operational environment, as well as no comprehensive mechanism for the collection, examination, or cataloging of damaged protective systems and equipment associated with combat injuries. As a result, program managers have no way of knowing how well their products are functioning on the battlefield; they are forced to rely on case reports and anecdotes, combined with sterile laboratory evaluations, when deciding whether to invest in product improvements. Frustrated vehicle and equipment developers have little information on which improvements will provide maximal protection. The USAARL framework provides a reliable estimation of protective system performance in present and future combat

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operations.

Operational Survival Analysis Section

The Operational Survival Analysis Section (OSAS) personnel have continued to be instrumental in developing short notice responses to U.S. Army and other government and non-government customers involving questions about eye protection, ear and hearing protection, as well as helping inform research groups about the distribution and types of wounds seen in the current conflicts. The section continues to collaborate via secured data and video conference venues with organizations globally.

Recent accomplishments include the production of a poster, “Prevention of injury in Mine Resistant Ambush Protected (MRAP) vehicle accidents” presented at the 12th Annual Force Health Protection Conference in Albuquerque, NM.

OSAS, represented by Mr. Dan Wise, LTC Shean Phelps, and Dr. Loraine St. Onge, attended and presented USAARL-produced/JTAPIC-related briefings and posters at the Annual Infantry Warfighting Conference hosted by the U.S. Army Infantry Center in Columbus, GA on 22-23 September 2009.

Other accomplishments include:

Cases Developed:

- USAARL Technical Memorandum 2009-07, Electrocutions/electrical related incidents
- 08-01, High Mobility Multipurpose Wheeled Vehicle (HMMWV) turret gunner restraint system; September 2007
- 08-02, HMMWV turret gunner restraint system; April 2008
- 08-03, Assessment of Aviation Life Support System Equipment (ALSE) in a shoot down event
- 08-05, Injury of occupants of HMMWV rollover accidents
- 09-02, Damaged Army Combat Helmet (ACH)
- 09-03, Aviation Shoot Down Assessment Team (ASDAT) CH-47F, OEF, January 2009
- Analysis of combat-related eye injury data and use of eye PPE: The Abbreviated Injury Score as an indicator of PPE use and effectiveness

U.S. Army Combat Readiness/Safety Center:

The OSAS established and has continued to foster a cooperative working relationship with U.S. Army Combat Readiness/Safety Center (USACR/SC) at Fort Rucker, AL to include development of a Memorandum of Agreement (MOA).

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Aviation Life Support Equipment Retrieval Program

The Aviation Life Support Equipment Retrieval Program (ALSERP) serves a vital role in maximizing the level of protection afforded to Army aircrew members by analyzing ALSE, studying injury mechanisms, tracking patterns, and bringing awareness to issues that can potentially decrease the level of protection afforded to Army aircrew members. Analyses of equipment and the discovery of deficiencies often prompt core research projects. In FY09, equipment from thirteen mishaps (U.S. Coast Guard [1], U.S. Air Force [1], and U.S. Army [11]) was sent to the ALSERP for analysis culminating in the submission of one quality deficiency report. Members of the ALSERP team deployed in support of four mishap investigations to Hawaii, Texas and two in the Fort Rucker area.

The OSAB purchased a digital microscope which has become a useful tool in ALSERP looking for microscopic evidence of failure in equipment.

ALSERP personnel continue to assist USARCR/SC personnel on-site at accident investigations, providing direction regarding post-crash protective equipment analysis, and improving dialogue between both organizations. Members of the ALSERP team visited the Materials Engineering Branch at Corpus Christi Army Depot and U.S. Army Aviation and Missile Research Development and Engineering Center (AMRDEC), Redstone Arsenal, AL, in order to establish a working relationship with engineers who may, in the future, be requested to support ALSERP by the performance of failure analysis of components.

ALSERP personnel presented at the ALSE convention in Huntsville, AL, providing insight into the role of the department and support available to personnel working in the field. In addition, ALSERP personnel demonstrated their capabilities and distributed reference material as part of the USAARL publicity booths at the ALSE convention, Huntsville, AL; the U.S. Army Medical Command (MEDCOM) safety conference, San Antonio, TX; and the SAFE Association conference, San Diego, CA.

ALSERP continues to contribute towards education of military and civilian personnel through presentations and guided tours of USAARL. The department hosts regular visits from the aviation safety officer, ground safety officer and flight surgeons courses. ALSERP personnel are constantly working to improve the quality and standard of visual aids and equipment used in these teaching sessions. ALSERP personnel also visited Auburn University as part of a USAARL promotion visit aimed at increasing awareness of USAARL facilities and possible recruitment for student placements.

Members of ALSERP are active in research examining mishap trends and contribution of safety equipment to prevention of injury.

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Injury Biomechanics Branch

The Injury Biomechanics Branch (IBB) research centers on the impact of a full spectrum of Army operational and training environments of Warfighters. The IBB is uniquely staffed with a multi-disciplinary team of biomechanical and aeronautical engineers, aviators, aerospace medicine specialists, safety professionals, and Soldiers. The team studies the effects of exposure to physical forces (e.g., localized and whole body impacts as well as repeated jolt) on the health, safety, and performance of U.S. Army aviation and ground, mounted, and dismounted Warfighters. The IBB team uses various standardized and unique methods (e.g., epidemiological research, computer modeling, laboratory simulation, use of crash manikins and human volunteers, investigation of mishaps, study of combat aircrew life support equipment and the investigation of ground vehicular incidents via its interaction with the ALSE and OSAB teams) and tools (i.e., helmet vertical drop tower, the MARS, and the NUH-60 Black Hawk Simulator). IBB team members serve on various inter-governmental and multi-national biodynamics research working groups that seek to develop internationally recognized, biomechanically validated injury standards and recommend injury prevention and protection strategies to researchers, equipment developers, and major commands alike.

Branch personnel were honored in FY09:

COL Ronald King, LTC Shean Phelps, and Dr. Carol Chancey were invited to chair an international panel of speakers at the 80th Annual Scientific Meeting of the Aerospace Medicine Association (AsMA) on the topic of Cervical Disc Surgery Options for Military Personnel.

LTC Shean Phelps was invited to present on biomechanics- and physiology-based modeling of blast wave TBI at the International Personal Armour Committee Workshop.

Mr. Frederick Brozoski and Dr. John Crowley (USAARL), and Dr. Stefan Duma and Dr. Eric Kennedy (Virginia Tech), and Mr. Paul Depinet and Mr. Craig Morgan (Denton, Inc.), were awarded the U.S. Army's Army Modeling and Simulation (M&S) Test and Evaluation Team Award for the development of the Facial and Ocular CountermeasUre Safety (FOCUS) head form at the 2008 Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC).

Neurosensory Injury Prevention Program

Major recent successes within the Neurosensory Injury Prevention Program include the approval of the Army Technology Objective (ATO) R.MRM.2010.06 Cervical SPine INjury Evaluation (CSPINE); the coordination and co-sponsorship of the Advanced Technologies and New Frontiers in Injury Biomechanics with Military and Aerospace Applications Workshop in Arlington, VA; the transition of and expansion of the FOCUS head form device; the establishment of the Biodynamics Data Resource (BDR), and the completion of the Breacher Injury Study.

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The IBB team continues to work closely with industry a variety of operational Army aviation units to provide testing protocols and rapid validation/certification of the protection provided by existing and novel flight helmets. In one case, evaluations conducted by the IBB team identified deficiencies in lateral impact protection provided by a candidate helmet, preventing it from being issued.

The IBB team worked with Project Management (PM)-Apache, PM-Air Warrior, and EFW, Inc., to evaluate the blunt impact protection provided by an HGU-56/P flight helmet equipped with a Magnetic Receiver Unit (MRU). The MRU is part of an overall weapons system upgrade for the AH-64 Apache helicopter. IBB's research showed the blunt impact protection of the HGU-56/P to be unaffected by the addition of the MRU, and provided the basis for a Safety of Flight release, allowing the modified HGU-56/P be worn by Army experimental test pilots during flight tests of newly-upgraded AH-64 Apache helicopters.

The IBB team also worked closely with JTAPIC, PM Soldier, Aberdeen Test Center (ATC), U.S. Army Natick Soldier Research Development and Engineering Center (NSRDEC), Naval Health Research Center (NHRC), Duke University, and Applied Research Associates (ARA) to evaluate combat helmets and combat helmet sensor systems. For the combat helmet evaluations, the IBB team collaborated with ATC and NSRDEC to develop and perform a dynamic retention evaluation test series and to establish a government test capability for lot acceptance testing for ACHs and future Enhanced Combat Helmets. With the combat helmet sensor systems, IBB established a relational database for helmet sensor field data from deployed Army and Marine Warfighters in OIF and OEF. With L3/Jaycor and the JTAPIC program office, IBB performed initial reviews and evaluations of the database and presented initial findings with recommendations for the next generation helmet sensor to helmet sensor stakeholders.

In the Spring of 2009, IBB scientists were awarded funding through the FY08 Intramural War Supplemental Research Program for the development of injury risk functions relating impact forces measured using the FOCUS head form to the risk of facial fractures during lateral impacts. The Virginia Tech Center for Injury Biomechanics, and the T.R.U.E. Research Foundation are currently collaborating with USAARL on the research protocol entitled, "Facial Fracture Injury Risk Functions for Assessing the Performance of Improved Face and Eye Protective Equipment."

In the Spring of 2008, the IBB team was successful in acquiring key research equipment and the internationally recognized biodynamics data repository from the Naval Biodynamics Laboratory (NBDL) in New Orleans, LA. The NBDL equipment and repository data were scheduled to be decommissioned and/or destroyed due to defunding and the result of damage to the facility by Hurricane Katrina in the fall of 2005. Through the IBB's long-cultivated collaborations with the U.S. Navy research community and with academia, the USAARL secured and assumed control of this national asset, safely archiving the data repository for future digitization and eventual utilization by biodynamics researchers world-wide.

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The USAMRMC-funded refurbishment of the vertical acceleration tower was completed in FY09 and it is anticipated additional FY10 to FY12 funding will permit refurbishment and housing of the vertical and horizontal acceleration sleds and supporting equipment. Working with USAARL, Fort Rucker, and USAMRMC facilities divisions, approval to begin design for the housing of the vertical accelerator and site approval for the vertical acceleration tower was obtained. The development of this capability within the region will provide much needed, highly technical infrastructure for USAMRMC, and further establish USAARL and the Fort Rucker, Alabama/Wiregrass area as a leader in the field of aeromedical/biodynamics research.

The IBB team collaborated with PM-Apache and U.S. Army Aviation Engineering Directorate (AED) to evaluate aviator concerns with current aircraft seat cushions. This effort followed a recent study of Army aircrew life support equipment effectiveness in OEF and OIF conducted by the Army Center for Lessons Learned that identified aircrew seating discomfort as a leading cause of loss of mission effectiveness.

Preliminary work conducted at USAARL has led to the development of cushion pressure distribution evaluation metrics. A comprehensive cushion performance survey of AH-64 and OH-58 Instructor Pilots provided baseline data about the currently fielded cushions. This data was presented at the 80th Annual Scientific Meeting of AsMA. Evaluations of the accuracy, fidelity, and reliability of the pressure mapping system and seat cushion component quasi-static objective metrics of seat comfort were investigated.

The IBB collaborated with other elements of USAARL and the U.S. Navy to conduct a two-phase, six-week long, field-based study investigating the impact of blast exposure on 31 USMC breachers. Breachers (or forced entry specialists) are frequently exposed to known blast loads and have noted some health effects related to this exposure. This study represents the first systematic research approach to help elucidate these health effects and try to relate them to the blast exposure.

Aviation Life Support Equipment

The objective of the ALSE section is to collect and analyze safety and protective equipment used or considered for use in U.S. Army aviation (and/or other DoD and non-DoD entities). Furthermore, this program is involved in the evaluation of aircraft interiors and other human factors issues within crew spaces. Results from this program frequently identify unforeseen or previously unrecognized gaps in deployed equipment subsystems, in levels of human tolerance, and/or in current protection research and as such are evaluated and transitioned into the core research program at USAARL and at the DoD-level through the USAARL's close associations with other research and development entities as well as through various PMs and Combat Developers.

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In FY09, the USAARL ALSE team participated in several projects, including the development, qualification testing, and fielding of the ZETA II Helmet Liners, Survival Kit, Readiness Access Modular (SKRAM) kit and the KA-BAR and Ontario Knife Source Selection study. USAARL's ALSE team led the assessment of the KA-BAR and Ontario Knife Source Selection study and the SKRAM kit for aviation survival use. Major modifications were recommended and implemented on the advice of Survival Evasion Resistance Escape (SERE) School Staff and USAARL senior aviator/subject matter expert (SME) team members, resulting in a knife and survival kit that will be more fully suited for the assigned tasks and expectations for its intended use. USAARL's ALSE team was an advocate for development, production, and fielding of fire protective clothing for aircrew and has continuously emphasized the need for the development of the Fire Resistant Environment Ensemble (FREE).

The ALSE section continued its highly successful helmet problems fit program, discovering over 30 custom helmet fitting solutions in FY09, and continues to monitor customer satisfaction..

Airworthiness Certification and Evaluation Branch

The Airworthiness Certification and Evaluation (ACE) Branch maintains the unique capability of testing and evaluating the efficacy of medical systems in the U.S. military aeromedical evacuation environment, ensuring the safe interaction among medical equipment, patients, aircrew, and aircraft. As such, the ACE Branch contributes to the protection of the injured or ill Warfighter through the MEDEVAC system.

Test and Evaluation Program

Under the aegis of the ACE Branch and at the request of the U.S. Army, U.S. Air Force (USAF), U.S. Navy, and USMC, airworthiness testing and/or certification was completed in FY09 for eight items of medical carry-on equipment for use aboard all H-series MEDEVAC helicopters. Currently, there are seven items of medical carry-on equipment being tested, and at the request of all other services, an additional 16 items are planned for testing in FY10, including the HH-60M Aeromedical Oxygen Generation System (AMOGS). The USAF testing laboratory at Brooks City-Base, San Antonio, TX, accepted ACE test data for multiple medical items. This interaction has streamlined the Joint Certification process.

In FY09, the ACE Branch continued to collaborate with the USMC. Through this coordination, the ACE Branch performed airworthiness test and evaluation on five items of medical carry-on equipment in the laboratory ensuring satisfactory operation in the military medical environment. This collaborative effort directly supported the Warfighter during aeromedical inter- and intra-theater transport throughout OEF, OIF, and other military operations. To respond quickly to USMC requirements, the ACE Branch immediately identified the need to have a mechanical drop tower and fabricated one at USAARL to expedite unique requirements such as transit drop testing.

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The ACE Branch hosted an Integrated Product Team meeting to discuss development, test and evaluation of three high priority items for USAMRMC. With high interest by the U.S. Army and USAF, this state-of-the-art medical equipment will be considered as the next Joint integrated medical solution for en route care.

In response to a capability gap and in coordination with the HH/UH-60 Project Management Office (PMO), AMRDEC, and USAMRMC, the ACE Branch tested and evaluated the AMOGS which is permanently installed onboard HH-60M helicopters. Findings revealed system performance capabilities as well as limitations and led to the issuance of a fleet-wide aeromedical certification for patient therapeutic use. In addition, the ACE Branch managed flight testing of 26 carry-on medical equipment items which led to fleet-wide acceptance aboard all HH-60M helicopters.

Through an urgent need identified by the Field Assistance in Science and Technology (FAST) team, the ACE Branch tested and certified an alternative power source needed for critical patient care monitoring during en route transport.

The ACE Branch gave formal presentations on test program updates at the Defense Medical Standardization Board (DMSB), Test, Evaluation, and Standardization Working Group (WG) meeting as well as the Global Patient Movement Joint Advisory Board (GPMJAB), sponsored by the U.S. Army Transportation Command (USATRANSCOM). During both meetings, ACE interfaced with key board members to understand Joint medical service requirements.

Standards Development Program

Based on the second tri-service meeting on patient movement items (PMI) testing held at USAARL in 2007, the ACE Branch developed a draft of the Joint En route Care Equipment Testing and Certification (JECETC) requirements. The JECETC document addresses revisions to the existing Joint Airworthiness Certification (JAC) requirements document to include ground and sea environments. Several changes to the JAC document were based on ACE Branch interaction with the Military Standard 810 (MIL-STD-810) WG. The ACE Branch continues to participate in MIL-STD-810 WG meetings to validate current ACE test methodologies and to discuss future inclusion of JECETC requirements into MIL-STD-810.

The ACE Branch partnered with the American Standardization for Testing and Material (ASTM) F30 Committee to develop a civilian test standard for en route care equipment. During FY09, two meetings were held with participation from the medical device industry and various government agencies.

ACE personnel continue to be extensively involved with the Air and Space Interoperability Council (ASIC) aimed at developing new standards which allow for international acceptance of medical carry-on items onboard host-nation platforms. The five ASIC nations (i.e., United States, United Kingdom, Canada, Australia, and New Zealand) also shared commonalities and interoperability issues experienced during tactical and strategic aeromedical operations.

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Research Activities

Shock and Vibration Isolation System for Patient Litters

Personnel in the ACE Branch are involved in identifying and developing shock and vibration isolation systems for patient litters used in ground and air MEDEVACs. Currently, the ACE Branch is collaborating with the University of Nevada Las Vegas to modify an existing air bladder technology to fit under a supine litter patient. This effort was funded by the U. S. Army Medical Materiel Development Activity (USAMMDA). A portion of the funds is directed to the ACE Branch for the test and evaluation of the shock and vibration isolation systems using the six-degree of freedom MARS facility at USAARL. Vehicle vibration signatures from an HH-60M helicopter were collected to provide realistic vibration profiles that will be recreated by the ride simulator during testing.

Sensory Research Division

Visual Sciences Branch

The Sensory Research Division (SRD) maintains a unique capability in the visual sciences as they relate to military operational medicine. The Division builds on its expertise in the clinical and allied vision sciences to enhance Warfighter effectiveness and safety in the evolving battlefield environment of today. The Division's vision science, optical, clinical, and technological capabilities provide a basis for the development and integration of optical and electro-optical displays in military systems; the evaluation physical, physiological, and functional vision associated with military occupational demands and combat, the definition of countermeasures to improve and preserve vision and visual efficiency, particularly as applied to unaided visual target detection, recognition, and identification. Of particular concern are the evolving threats to the visual system posed by battle field blast injuries.

Sensory Biomarkers for Traumatic Brain Injury

It is generally agreed that more than 50% of the brain processing involves the visual system and the cognitive processes associated with visual perception. This creates the potential for vision to serve as an indicator of the integrity of the brain. Current research is directed toward developing the rich potential of vision as a tool for assessing and diagnosing the effects of mild traumatic brain injury (mTBI). Thus the assessment of vision provides insight into the effects of mTBI on the ability of patients/Warfighters to see at the same time that the assessment provides insight into the effects of the trauma on the brain.

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Advanced Optical Measurement and Correction

The objective of this research was to determine the operational efficacy of refractive surgery for specialized Army applications. Additionally, higher order aberration of the eye, as well as corneal physiological modeling, are being investigated to enhance visual performance to 20/8 or better. If found safe and effective, these techniques will provide the capability to increase the recruitment population, enhance visual performance levels, and potentially increase future mission success in visually demanding military occupational specialties.

Oculometrics and Other Sensory Indices of Alertness, Fatigue, and Time-on-Task

This research aims to assess biologic indices of Warfighter fitness for duty using real-time measurements that could be incorporated into the Warfighters' battledress. Research is directed for the simultaneous measurement of an operational task (e.g., rotary wing hover performance) with biologic measures to yield correlational indices of fatigue, alertness, and operational performance.

Advanced Display Concepts and Physiological Optics

This research will improve image output standards to optimize visual performance with advanced electro-optical designs and visual performance models to predict Warfighter performance in operational environments. The National Research Council, in its review of tactical displays for Warfighters, identified a major weakness in the understanding of human factors related to perceptual and cognitive issues with such devices.

Visual Performance Modeling

The objective of this research was to develop computer models of human physiology and performance and models of military hardware and operational stressors to assess human performance in an operational environment. Models of interest include health hazards of impulse noise from crew-served weapon systems; helmet-mounted and head-up display (HMD/HUD) models for day-night operations; target detection and identification models; and sensory processing models.

Acoustics Research Branch

The SRD maintains a unique capability in acoustics research. The objectives of the Acoustics Research Branch are to conduct research to improve the operational capabilities of Army aviation, mounted, and ground forces by predicting and reducing hazards from excessive exposure to noise and to improve the safety and mission capabilities of Army personnel by improving the auditory displays and communications systems utilized in military aircraft and ground vehicles. Warfighters' survivability depends on accurate sensory perception of the environment. Despite the technological advances in hearing protective devices, the likelihood of

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exposure to continuous and impulse noise on the modern battlefield remains high. As a result, the prevalence of hearing loss and tinnitus in returning OIF and OEF Soldiers is at an all-time high; making protection of the critical sense of hearing a priority of the Acoustics Research program. Warfighter auditory performance research efforts focus on prevention of noise-induced hearing loss and enhancement of auditory performance. Furthermore, research efforts are focused on evidence-based criteria for standards to determine the level of operational competence required to RTD following an auditory or vestibular injury.

Hearing Hazards in Army Operations

This program investigates and evaluates hazards to hearing in the Army operational environment. Principally, this includes noise in rotary-wing and mounted environments but also includes impulse noise hazards for mounted and dismounted Warfighters which is measured using specifications of MIL-STD-1474D “Noise Limits.” In rotary-wing environments, noise measurements are made on both sides of the pilot’s head and at the unoccupied copilot (observer) position at approximate head height during specific flight maneuvers and aircraft configurations. Measurements are also made during weapon firing to measure impulsive noise. An example of quantifying a dismounted operational environment would be the measurement of blast overpressure at the Marine Breacher Training Academy in Quantico, VA. Furthermore, while the most common hazard to hearing is high-level continuous and impulse noise, other hazards may include ototraumatic and ototoxic agents such as inhalants, disease, and drugs.

Hearing Protection and Enhancement for the Warfighter

This program focuses on traditional and advanced technologies and systems to enhance hearing while protecting the vital survival sense of hearing in the combat environment. As stated previously, exposure to dangerous levels of combat noise is causing an epidemic of high rates of acute and chronic acoustic injuries. New technologies can prevent most of these injuries while preserving combat effectiveness. Non-linear hearing protection and communication systems provide the dismounted Warfighter with hearing protection and communication while still allowing enhanced situational awareness of the battlefield and face-to-face and wireless communications. Non-linear hearing protective devices permit normal or near-normal hearing during periods of quiet or low-level noise while providing protection from the very high impulse noises generated by friendly or opposing forces weapon systems. Research is focused on laboratory evaluations of commercial off-the-shelf (COTS) non-linear hearing protection and communication systems and includes quantification of hearing protection, speech intelligibility, sound localization, and signal detection and recognition.

Auditory Performance in Army Tactical Environments

This program encompasses research on human auditory performance, typically in noise, by normal and hearing-impaired listeners. The objective is to enhance the safety and operational mission capabilities of Warfighters by evaluating new hearing protection and enhancement

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technologies for use by normal hearing and hearing-impaired listeners. Additional research in this area examines a novel tinnitus treatment to reduce the debilitating operational effects of tinnitus resulting from blast and other acoustic trauma.

Bioacoustics and Noise Standards

The program emphasizes collaborative work in conjunction with the Acoustical Society of America's standards working groups on acoustical hazards and hearing protection measurement methods. Acoustic Research Branch personnel serve on several standards working groups. The current ANSI method for testing the effectiveness of hearing protective devices was developed with participation by USAARL investigators. The Acoustics Science Branch has engaged in a multi-laboratory, multi-national research program that has resulted in the revision of standard ANSI S12.6 Methods for Measuring the Real-Ear Attenuation of Hearing Protectors.

Sensory Biomarkers for Traumatic Brain Injury

Nearly 80% of the brain's processing involves sensory signals and cognition associated with sensory perception. In-house research is directed at finding electrophysiological and/or performance indices that may provide early diagnosis of mild traumatic brain injury. Recent projects are evaluating the ability of electrophysiological brainstem measures to differentiate brain-injured Soldiers from those without brain injuries. Similarly, research is being focused toward the development of vestibular and oculomotor biomarkers of traumatic brain injury to aid in the development of return-to-duty standards.

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Research Activities

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Rash, C., Kalich, M., Viskup, B., Tillman, N., Ramiccio, J., & McLean, W. (2009). *A Limited Rotary-Wing Flight Investigation of Hyperstereo in Helmet-Mounted Display Designs*. (Report No. 2009-15). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory. (Defense Technical Information Center No. ADA504208).

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Technical Memoranda

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- McLean, W. (26 January 2009). *Optical Properties Assessment of the SPH-4 Visor for Joint Service Aircrew Mask (JSAM) from the Repaired Mold.* (Memorandum No. 2009-03). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.
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- Eshelman, R. (9 June 2009). *Test Results for the Advanced Systems Integration (ASI) Medical Incorporated TritonTM Standard Self-contained Delivery System, model 2025M.* (Memorandum No. 2009-06). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.
- Giffin, R. (17 June 2009). *Electrocutions/electrical related incidents.* (Memorandum No. 2009-07). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.
- Morgan, H. (19 June 2009). *Aviation Life Support Equipment Retrieval Program Case No. 09-01, Class A Mishap, U.S. Coast Guard, Class A Mishap, HH-65C Dolphin, Honolulu, HI, 4 September 2008.* (Memorandum No. 2009-08). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.
- Eshelman, R. (22 July 2009). *Test Results for the ZOLL Medical Corporation Modified CCT with XL Smart (EMI Shielded and Unshielded) Batteries.* (Memorandum No. 2009-09). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.
- Morgan, H. (14 August 2009). *Aviation Life Support Equipment Retrieval Program Case No. 09-03, Class A Mishap, UH-60L, Texas A&M Campus, 12 January 2009.* (Memorandum No. 2009-10). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.

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Reeves, E. (25 September 2009). *Acoustic Assessment of the HGU-56P Flight Helmet with Communications Enhancement and Protection System (CEPS).* (Memorandum No. 2009-12). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.

Edited Books

Rash, C. E., Russo, M., Letowski, T., & Schmeisser, E. (Eds). (2009). *Helmet-mounted Displays: Sensation, Perception, and Cognition Issues.* Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.

Book Chapters

Bayer, M. M., Rash, C. E., & Brindle, J. H. (2009). Introduction to helmet-mounted displays. In Rash, C. E., Russo, M., Letowski, T., & Schmeisser, E. (Eds), *Helmet-mounted Displays: Sensation, Perception, and Cognition Issues* (pp. 47-108). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.

Capo-Aponte, J. E., Temme, L. A., Task, H. L., Pinkus, A. R., Kalich, M. E., Pantle, A. J., & Rash, C. E., (2009). Visual perception and cognitive performance. In Rash, C. E., Russo, M., Letowski, T., & Schmeisser, E. (Eds), *Helmet-mounted Displays: Sensation, Perception, and Cognition Issues* (pp. 335-390). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.

Francis, G. S., & Rash, C.E. (2009). Cognitive factors. In Rash, C. E., Russo, M., Letowski, T., & Schmeisser, E. (Eds), *Helmet-mounted Displays: Sensation, Perception, and Cognition Issues* (pp. 619-674). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.

Francis, G. S., Rash, C. E., & Russo, M. B. (2009). The human-machine interface challenge. In Rash, C. E., Russo, M., Letowski, T., & Schmeisser, E. (Eds), *Helmet-mounted Displays: Sensation, Perception, and Cognition Issues* (pp. 29-46). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.

Hiatt, K.L., & Rash, C.E. (2009). The military operational environment. In Rash, C. E., Russo, M., Letowski, T., & Schmeisser, E. (Eds), *Helmet-mounted Displays: Sensation, Perception, and Cognition Issues* (pp. 3-28). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.

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Melzer, J. E., Brozoski, F. T., Letowski, T. R., Harding, T. H., & Rash, C. E. (2009). Guidelines for HMD design. In Rash, C. E., Russo, M., Letowski, T., & Schmeisser, E. (Eds), *Helmet-mounted Displays: Sensation, Perception, and Cognition Issues* (pp. 805-848). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.

Melzer, J. E., & Rash, C. E. (2009). The potential of an interactive HMD. In Rash, C. E., Russo, M., Letowski, T., & Schmeisser, E. (Eds), *Helmet-mounted Displays: Sensation, Perception, and Cognition Issues* (pp. 878-898). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.

Rash, C. E., Bayer, M. M., Harding, T. H., & McLean, W. E. (2009). Visual helmet-mounted displays. In Rash, C. E., Russo, M., Letowski, T., & Schmeisser, E. (Eds), *Helmet-mounted Displays: Sensation, Perception, and Cognition Issues* (pp. 109-174). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.

Rash, C. E., Hiatt, K. L., Wildzunas, R. M., Caldwell, J. L., Caldwell, J. A., Kalich, M. E., Lang, G. T., King, R. P., & Noback, R. N. (2009). In Rash, C. E., Russo, M., Letowski, T., & Schmeisser, E. (Eds), *Helmet-mounted Displays: Sensation, Perception, and Cognition Issues* (pp. 675-804). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.

Temme, L. A., Kalich, M. E., Curry, I. P., Pinkus, A. R., Task, H. L., & Rash, C. E. (2009). Visual perceptual conflicts and illusions. In Rash, C. E., Russo, M., Letowski, T., & Schmeisser, E. (Eds), *Helmet-mounted Displays: Sensation, Perception, and Cognition Issues* (pp. 491-578). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory.

Presentations

COL Ronald King, CW5 Herman Morgan, and Mr. Robert Giffin presented an overview of USAARL's Operational Survival Analysis Branch (i.e., ALSERP and JTAPIC) at the Tank Automotive Research Development and Engineering Center (TARDEC) in Warren, MI. The USAARL team also toured the TARDEC facilities and exchanged briefings with TARDEC staff as well as staffs for Program Managers MRAP, Bradley, HMMWV, and Light Tactical Vehicle (LTV). 30 September-2 October 2008.

Dr. Khalid Barazanji and Mr. Bobby Bowers presented an overview of the Airworthiness Certification and Evaluation program to members of the ASTM International F-30 community at the Aeromedical Transportation Conference in Minneapolis, MN. 19-23 October 2008.

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Dr. Melvyn Kalich presented USAARL's Helmet Mounted Display decision matrix at Raytheon in McKinney, TX. The decision matrix will serve to guide the selection of an aviator HMD and crew HMD for the Operational Pilotage for Utility and Lift (OPUL) program. Raytheon is the prime contractor on the OPUL ATO which is administered through the Night Vision Electronic and Sensor Directorate, Fort Belvoir, VA. 22-24 October 2008.

Dr. Angus Rupert and Mr. Casey Harris provided demonstrations on the USAARL Cobra Tactile Situation Awareness System (TSAS) Demonstrator at the SAFE Association's 46th Annual Symposium in Reno, NV. The symposium provides an internationally attended marketplace for the exchange of technical information, product and service exhibitions, and the showcasing of industry capabilities for meeting challenges in vehicular occupant protection and personnel-worn safety equipment. 27-29 October 2008.

Dr. Thomas Harding and Dr. Melvyn Kalich gave briefings on the HMD selection for the OPUL helicopters sensor system program to personnel of the U.S. Army Research, Development and Engineering Command (RDECOM) Communications and Electronics Research, Development and Engineering Center (CERDEC) Night Vision and Electronic Sensors Directorate (NVESD) at Fort Belvoir, VA. 12-14 November 2008.

Dr. Amanda Kelley presented a paper entitled "Risky behaviors and attitudes about risk in soldiers," at the Society for Judgment and Decision-Making (SJDM) Conference in Chicago, IL. 15-17 November 2008.

Dr. Carol Chancey presented to representatives from the JTAPIC PMO "USAARL update helmet sensor project: Data observations from theater, field, and laboratory" in Fort Rucker, AL. December 2008. Mr. Brad Bumgardner, Mr. Fred Brozoski, Ms. Katie Padgett, Mr. Joe McEntire, and LTC Shean Phelps co-authored the presentation.

Dr. Arthur Estrada and Dr. Stefan Duma (Virginia Tech-Wake Forest, Center for Injury Biomechanics, Blacksburg, VA) presented posters and Dr. Angust Rupert gave a verbal presentation at the 26th Annual Army Science Conference (ASC) held in Orlando, FL. Dr. Rupert and Mr. Frederick Brozoski participated in the Army Unified exhibit by providing demonstrations of TSAS and FOCUS, respectively. In association with ASC, the I/ITSEC presented Mr. Brozoski the "U.S. Army's Modeling and Simulation Award for Testing and Evaluation" for developing the FOCUS head form. This award was won by the team of scientists and engineers from USAARL (represented by Mr. Brozoski and Dr. John Crowley), the Virginia Tech-Wake Forest Center for Injury Biomechanics, and Denton, Inc. 1-4 December 2008.

Kilgore, W. S., Estrada, A., Wildzunas, R., & Balkin, T. Sleep and performance measures in Soldiers undergoing military training.

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Rupert, A. & Kolev, O. (Medical University of Sophia, Sophia, Bulgaria) The use of tactile cues to modify the perception of self motion.

Bisplinghoff, J. Cormier, J., Duma, S., Kennedy, E., Depinet, P. & Brozoski, F. Facial fracture criteria for the FOCUS head form.

Dr. Art Estrada presented “Performance sustainment of two man crews during 87 hours of extended wakefulness with stimulants and napping” at the Special Operations Medical Association (SOMA) 21st Annual Conference, in Tampa, FL. 13-18 December 2008.

LTC Shean Phelps presented a USAARL research program briefing to the U.S. Navy Operational Aeromedical Problems Course at the Naval Air Station in Pensacola, FL. 14 January 2009.

LTC Shean Phelps presented an ATO C-SPINE (R.MRM.2010.06) brief at the U.S. Army Medical Research and Materiel Command in Fort Detrick, MD. 24, 29-30 February 2009.

LTC Shean Phelps presented “Bridging the Operational Gap with Research” at the 3rd Annual Medicine in Challenging Environments (MICE) conference in Galveston, TX. 2-6 January 2009.

Dr. Parrish Balcena, Mr. Daniel Wise, Mr. Robert Giffin, Dr. John Johnson, and Mr. Kraig Pakulski presented “Accident Review from Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF)” at the National Ground Intelligence Center’s (NGIC) Anti-Armor Task Force (AATF) Semi-Annual in Progress Review in Charlottesville, VA. 27-29 January 2009.

Dr. William Ahroon presented “Hearing Protection and Hearing Enhancement in One Device: Perspective of the Soldier Whose Ears and Life Depend Upon it” at the annual National Hearing Conservation Association in Atlanta, GA. 11-14 February 2009.

Mr. Robert Giffin presented “Accident Review from Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF)” and “Mine Resistant Ambush Protected (MRAP) Vehicle Accident Analysis” at TARDEC in Warren, MI. 19-20 February 2009.

COL Joseph McKeon presented on his experiences as an Army physician and the benefits of service at the University of West Florida in Pensacola, FL. 27-28 February 2009.

LTC Shean Phelps presented “The Biodynamics Data Resource (BDR) and other data sources available to USAARL” at the NATO Human Factors and Medical Panel (HFM)-ET-086, Database of Biomechanical Analysis Joint Working Group Meeting in Paris, France. 1-5 March 2009. Dr. Carol Chancey, Ms. Allison Schmidt, Ms. Kimberly Vasquez, and Ms. Alexandria Sumner co-authored the presentation.

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Dr. Efrem Reeves presented “Essential Information for the Audiologist Researcher” at the Joint Defense/Veterans Administration Audiology Conference in Mesa, AZ. 2-4 March 2009.

Mr. Joe McEntire presented the U.S. Army Aeromedical Research Laboratory ACH impact test results at the Head Protection Conference in Haymarket, VA. 10 March 2009.

Members of the Breacher Injury Study Research Consortium presented “Breacher Injury Study final briefing” at the Breacher Injury Study Consortium meeting held in Arlington, VA. 24 March 2009. USAARL researchers participating in the Breacher Injury Study included Dr. Carol Chancey, Dr. Melinda Hill, Dr. Paul St. Onge, Mr. Fred Brozoski, and Ms. Allison Schmidt.

Dr. Paul St. Onge presented “AH-64 Seat Cushion Update” at the PM-Apache Maintenance Officers Conference in Reno, NV. 24-28 March 2009.

Dr. Scott Killgore from the Harvard University’s McLean Neuroimaging Center presented “Development and validation of a scale to measure the perception of invincibility” at the 29th Annual Anxiety Disorders Association of America conference, in Albuquerque, NM. 5-8 March 2009. The presentation was co-authored by Dr. Amanda Kelly of USAARL and Dr. Thomas Balkin of the Walter Reed Army Institute of Research.

Dr. Carol Chancey and Mr. Joe McEntire presented “Spinal Dynamic Response Index” and “Injury Assessment Reference Values: Development, Application, and Limitations” and Mr. Fred Brozoski presented “Novel Facial/Ocular Injury Protection Assessment: The FOCUS Headform” at the Army Research Laboratory’s Personnel Vulnerability Workshop in Aberdeen Proving Ground, MD. 7-10 April 2009.

Dr. Arthur Estrada briefed the Special Operations Command (SOCOM) Biomedical Initiatives Steering Committee (BISC) on the SOCOM study in Tampa, FL. 8-11 April 2009.

Dr. Carol Chancey and Mr. Joe McEntire presented “Spinal Dynamic Response Index” at the Army Research Laboratory’s Personnel Vulnerability Workshop in Baltimore, MD. 7-10 April 2009. Dr. Chancey also presented “Novel Facial/Ocular Injury Protection Assessment: The FOCUS head form” on 9 April 2009.

Dr. Thomas Harding, Dr. Melvyn Kalich, and Mr. Ed Rash presented co-authored papers at the International Society for Optical Engineering (SPIE) conference in Orlando, FL. 14-16 April 2009.

Kalich, M., Rash, C. E., Harding, T., Jennings, S., Craig, G., & Stuart, G. Flight performance using a hyperstereo helmet-mounted display: Post-flight debriefing questionnaire.

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Jennings, S., Craig, G., Stuart, G., Kalich, M., Rash, C., & Harding, T. Flight performance using a hyperstereo helmet-mounted display: Aircraft handling

Stuart, G., Jennings, S., Kalich, M., Rash, C., Harding, T., & Craig, G. Flight performance using a hyperstereo helmet-mounted display: Adaptation to hyperstereopsis.

Mr. Bobby Bowers presented on medical equipment airworthiness testing at the Design of Medical Devices Conference sponsored by the University of Minnesota, Minneapolis, MN. 14-15 April 2009.

LTC Shean Phelps presented “Biomechanics and physiology based modeling of military helmet protection against blast wave traumatic brain injury” at the International Personal Armour Committee Workshop in Paris, France. 21-22 April 2009. The presentation is co-authored by Mr. Joe McEntire and Dr. Carol Chancey of USAARL and Andrzej Przekwas of CFD Research Corporation.

Ms. Catherine Webb presented “Simulator Sickness in the Flight School XXI TH-67 Flight Motion Simulators,” at the 15th International Symposium on Aviation Psychology in Dayton, OH. 27-30 April 2009.

USAARL researchers presented at the 80th Annual Scientific Meeting of AsMA, Los Angeles, CA. 3-8 May 2009.

Campbell, B., St. Onge, P., & Licina, J. Flight medic assessment of the UH-72A MEDEVAC configuration modified with FAA-approved MEDEVAC mission support kit.

Hewett, K., Curry, I. P., Rath, E., Collins, S., & Saini, N. Subtle cognitive effects of moderate hypoxia.

Kelley, A.M., Killgore, W., Athy, J., & Dretsch, M. Risk propensity, risk perception, risk aversion, and sensation seeking in U.S. Army Soldiers.

King, R. P., Phelps, S. E., & Chancey, V. C. Operational impact of cervical disc surgery options for military personnel.

Shivers, B., Chancey, C., Phelps, S. E., St. Onge, P. A literature review of *in vivo* human cervical disc implants.

Still, D., Temme, L., Martin, S., & Harding, T. The quantification and analysis of eye movements and flight performance in four Army aviators: Instrumentation, calibration, and data.

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St. Onge, P., Riddle, M. E., McEntire, J., Chancey, C., Schmidt, A., Brozoski, F. Instructor pilot survey of standard seat cushion sets.

Temme, L., Still, D., & Acromite, M. The Effects of hypoxia on the flight performance of active duty, instructor pilots in fixed-wing simulator.

Webb, C., Estrada, A., & Athy, J. Motion sickness prevention by stroboscopic environment during military transport.

COL Joseph McKeon and Mr. Robert Giffin presented an overview of USAARL's ALSERP and JTAPIC Program to the Senior Aviation Safety Officers' Course at the USACRC/SC in Fort Rucker, AL. 1 May 2009.

Mr. Robert Giffin presented "Mine Resistant Ambush Protected (MRAP) Accident and Injury Analysis" at the Mine Resistant Ambush Protected (MRAP) Joint Systems Safety Working Group (JSSWG) meeting in Warren, MI. 19-20 May 2009.

Dr. Angus Rupert presented "Edge of the Envelope- Technology Advances in Flight Simulation" to the Royal Aeronautical Society in London, UK. 31 May 2009.

Dr. Loraine Parish St. Onge and Dr. Mary Rudisill presented "Preschoolers' physical activity response to three different motivational climates: Mastery, performance, and free play" at the North American Society of the Psychology of Sport and Physical Activity (NASPSPA) Conference in Austin, TX. 12 June 2009.

X. G. Tan from CFD Research Corporation presented "Development of physics-based model and experimental validation of helmet performance in blast wave TBI" at the American Society of Mechanical Engineers Summer Bioengineering Conference in Lake Tahoe, CA. 17-21 June 2009. Co-authors on this presentation included Dr. Carol Chancey of USAARL, Andrzej Przekwas, Z. J. Chen, P. Wilkerson, A. Zhou, V. Harrand, and Dr. Debbie Reeves of CFD Research Corporation and Celina Imielinska of Columbia University.

Dr. Khalid Barazanji presented a briefing on medical oxygen systems airworthiness requirements to the Oxygen Standardization Coordinating Group (OSCG) 2009 meeting in Reno, NV. 7-8 July 2009.

CW5 Herman Morgan presented on helicopter/heliport safety at the 2009 Army Medical Symposium and Exposition in San Antonio, TX. 20-24 July 2009.

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USAARL's Injury Biomechanics Branch co-sponsored and presented at the Advanced Technologies and New Frontiers in Injury Biomechanics with Military and Aerospace Applications Workshop in Arlington, VA. 4-5 August 2009. Dr. Carol Chancey presented "Head supported mass (HSM) injury risk and biomechanical evaluation," Mr. Joe McEntire presented "In-depth military helicopter accident investigations," and Mr. Fred Brozoski presented "FOCUS response to blast loading."

Mr. Robert Giffin presented an accident and injury analysis briefing to TARDEC Technology Review for FAST team members at TARDEC headquarters in Warren, MI. 13 August 2009.

Mr. Dan Wise, Dr. John Johnson, Mr. Kraig Pakulski, Mr. Jeremy Athy, and CPT Michael Dretsch of USAARL and Dr. Scott Killgore of the Harvard University's McLean Neuroimaging Center presented posters at the 12th Annual Force Health Protection Conference, sponsored by the U.S .Army Center for Health Promotion and Preventive Medicine (USACHPPM) in Albuquerque, NM. 17-22 August 2009.

Pakulski, K., Johnson, J., Giffin, R., Balcena, P., Wise, D., & St. Onge, P. Prevention of Injury in Mine Resistant Ambush Protected (MRAP) Vehicle Accidents.

Kelley, A. M., Webb, C. M., Athy, J. R., Ley, S., & Crowley, J. S. A meta-analysis of cognition-enhancing drugs and their appropriateness for use in ground and aviation troops.

Killgore, W. D. S., Kelley, A. M., & Balkin, T. Development and validation of a scale to measure the perception of invincibility.

Russell, M., Parish, R., Kelly, M., & Dretsch, M. Validity, Sensitivity, and Specificity of the ANAM and the MACE in the deployed environment.

Mr. Robert Giffin presented an accident and injury analysis briefing at the MRAP Joint Training in Progress Team (JTIPT) in Salt Lake City, UT. 18 August 2009.

LTC Shean Phelps, Mr. Joe McEntire, and Dr. Carol Chancey presented "An update on CDMRP project #PT075377: Helmet mounted sensor recorded blast data in combat" at the Helmet Sensor Data Analysis Update meeting held via teleconference from Fort Detrick, MD.18 August 2009.

Mr. Robert Giffin presented an accident and injury analysis briefing at the Joint User Working Group (JUWG) in Salt Lake City, UT. 19 August 2009.

Lt Col Lynne Walters and CW5 Herman Morgan presented "The Aviation Life Support Equipment Retrieval Program" and Mr. Keith Northcutt presented "The Role of USAARL in ALSE" at the ALSE Conference in Huntsville, AL. 25-27 August 2009.

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Dr. John Crowley, Mr. Joe McEntire, and Dr. Leonard Temme presented at the 2009 Medical Health Research Forum (MHRF) in Kansas City, MO. 31 August-3 September 2009.

Crowley, J. S., Ivins, B., McEntire, B. J., & Schwab, K. Efficacy of countermeasures against traumatic brain injuries sustained in airborne operations.

McEntire, B. J., & Chancey, V. C. Transfer function development for helmet-mounted sensors.

Temme, L. The effects of hypoxia on cognitive function in aviators and complex system operators that have had a mild traumatic brain injury.

Dr. John Crowley presented at the 57th International Congress of Aviation and Space Medicine in Zagreb, Republic of Croatia. 6-10 September 2009.

McGhee, J., King, R., Persson, J., Phelps, & S., Crowley. Cervical disk replacement surgery and fitness to fly: The U.S. Army experience.

Pettyjohn, F., McKeon, J., Persson, J., & Quattlebaum, M. Asthma and Bronchospastic Disease in aircrew- An aeromedical problem.

Grant Proposals

Ahroon, W. A. & Hill, M. (Co-Principal Investigators). *Evaluation of a new treatment for tinnitus secondary to blast and mTBI*. FY08 DoD Peer Reviewed Medical Research Program, Advanced Therapeutic/Technology Development Award. \$2,473,839 (not funded).

Ahroon, W. A. & Hill, M. (Co-Principal Investigators). *Tinnitus and brainstem integrity following blast and TBI*. FY08 DoD Peer Reviewed Medical Research Program, Investigator Initiated Research Award. \$1,189,430 (not funded).

Ahroon, W. A. (Principal Investigator). *Injury prevention: Blast from small caliber arms fire*. FY08 DoD Deployment Related Medical Research Program, Advanced Therapeutic/Technology Development Award. \$15,250,598 (not funded).

Ahroon, W. A. (Principal Investigator). *Auditory, vestibular, and cognitive effects from repeated blast*. FY08 USAMRMC Intramural War Supplemental Program. \$1,848,383 (funded).

Ansorge, E. & Ahroon, W. A. (Co-Principal Investigators). *Evaluation of the noise-immune stethoscope in clinical settings*. FY08 DoD Deployment Related Medical Research Program, Advanced Therapeutic/Technology Development Award. \$636,514 (not funded).

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Barazanji, K. (Principal Investigator). *Development of Traumatic Brain and Spinal Injury Transport (TBASIT) Litter Kit.* FY08 USAMRMC Intramural War Supplemental Program. \$1,457,865 (not funded).

Barazanji, K. (Principal Investigator). *Repeated shock and vibration exposure limits for trauma patients: Development of a standard.* FY08 USAMRMC Intramural War Supplemental Program. \$2,011,022 (not funded).

Brozoski, F. (Principal Investigator). *Facial fracture injury risk functions for assessing the performance of improved face and eye protective equipment.* FY08 USAMRMC Intramural War Supplemental Program. \$448,375 (funded).

Capo-Aponte, J. (Principal Investigator). *Determination of neurosensory biomarkers for early diagnosis and management of concussive Traumatic Brain Injury (cTBI): Remote post-deployment neurosensory evaluation.* FY08 USAMRMC Intramural War Supplemental Program. \$2,112,796 (not funded).

Capo-Aponte, J. (Principal Investigator). *Determination of novel strategies for hastening corneal wound healing and reducing tissue inflammation.* FY08 USAMRMC Intramural War Supplemental Program. \$360,453 (funded).

Chancey, V. C. (Co-Investigator). *Breacher injury dtudy: Cumulative effects of chronic blast exposures.* FY08 DoD Deployment Related Medical Research Program, Advanced Therapeutic/Technology Development Award. \$5,901,369 (not funded).

Dretsche, M. (Principal Investigator). *Imaging biomarkers of selected serotonin re-uptake inhibitor (SSRI) efficacy for treatment of combat operational stress.* FY08 USAMRMC Intramural War Supplemental Program. \$1,025,775 (not funded).

Dretsche, M. (Associate Investigator). *Identification and Validation of Central Mechanisms (Biomarkers) of Sustained Impairment in Chronic TBI.* FY09 Psychological Health and Traumatic Brain Injury Research Program. \$1,346,298 (pending).

Dretsche, M. (Associate Investigator). *Neuroimaging Biomarkers and Virtual Reality Differentiation of Mild TBI and PTSD.* FY09 Psychological Health and Traumatic Brain Injury Research Program. \$1,620,164 (pending).

Dretsche, M. (Associate Investigator). *Omega-3 Fatty Acids and Cognitive Outcomes in Soldiers Deployed to Combat Areas.* FY09 Psychological Health and Traumatic Brain Injury Research Program. \$496,000 (pending).

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Dretsche, M. (Associate Investigator). *Remote Monitoring and Characterization of Cognitive Status by Telephone in Mild TBI*. FY09 Psychological Health and Traumatic Brain Injury Research Program. \$1,245,893 (pending).

Dretsche, M. (Consultant). *Sensitivity and Specificity of Oculomotor Function for TBI Diagnosis*. FY09 Psychological Health and Traumatic Brain Injury Research Program. \$331,576 (pending).

Dretsche, M. (Co-Principal Investigator). *Biomarkers of Post-Traumatic Stress Disorder and SSRI Treatment Efficacy*. FY09 Defense Medical Research and Development Program. \$1,108,000 (pending).

Dretsche, M. (Consultant). *Project BLAST: The Balad Longitudinal Assessment of the Symptoms of TBI/PTSD*. FY09 Defense Medical Research and Development Program. \$593,000 (pending).

Dretsche, M. (Co-Principal Investigator). *Biomarkers of Post-Traumatic Stress Disorder and SSRI Treatment Efficacy*. National Institutes of Health, RO1Research Project Grant. \$1,108,000 (pending).

Dretsche, M. (Associate Investigator). *Effects of Injury Mechanism on Cerebral White Matter Burden in Mild TBI*. Veterans Affairs Grant. \$1,100,000 (pending).

Dretsche, M. (Associate Investigator). *Creating Proteomic Profiles and Assessing Cognitive Functioning in OEF/OIF Veterans with PTSD and those with comorbid mTBI*. Veterans Affairs Grant, Health Services Research and Development, Merit Review Award, Pilot Project Program. \$100,000 (pending).

Dretsche, M. (Associate Investigator). *Validation of Brain Stem Nuclei FA Values as Biomarkers of mTBI*. FY09 Spinal Cord Injury Research Program, Investigator-Initiated Research Award. \$1,300,000 (pending).

Estrada, A. (Co-Principal Investigator). Sensorimotor Displays and Controls to Enhance Lunar Landing. *National Space Biomedical Research Institute*. \$60,490 (funded).

Rupert, A. (Principal Investigator). *Post-concussion tools to assist with assessment, treatment, and return to duty*. FY08 USAMRMC Intramural War Supplemental Program. \$817,970 (funded).

Temme, L. A. (Principal Investigator). *Field-portable retinal oximeter*. FY08 USAMRMC Intramural War Supplemental Program. \$899,682 (not funded).

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Research Seminars

In January 2003, the USAARL began a series of research seminars. The purpose of these seminars is to promote communication and discussion about scientific interests, achievements, research methods and general principles among our laboratory staff members. Seminar presentations are offered by members of the USAARL research staff and, through invitation, by qualified visitors. Announcements of seminar presentations are sent to the entire USAARL staff, several divisions of the U.S. Army Aeromedical Center (Lyster Army Health Clinic), and the USACRC/SC.

The following seminars were offered during FY09:

Date: Thursday, 23 October 2008

Place: USAARL Lecture Room

Speaker: LTC James Persson (U.S. Army Aeromedical Activity [USAAMA])

Title: Water Quality and Disease Rates

Abstract: Manna Energy Organization is a group of aerospace professionals (astronauts, National Aeronautics and Space Administration [NASA] engineers and aerospace businessmen) committed to bringing clean water to people in Rwanda. In order to fund over 400 projects in this developing nation, the organization is working with the United Nations to fund these projects using the carbon credit mechanism described in the Kyoto Accord. As part of the development process, a review of medical literature was conducted to investigate the effect of water quality on disease rates in developing nations. Although the project will bring clean water to potentially thousands of people, past research has shown that emphasis on water quality alone has only a minimal effect on disease rates in these nations. This presentation will address the past, present and possible future ramifications of the research findings.

Date: Thursday, 26 February 2009

Place: USAARL Lecture Room

Speaker: Dr. Mark Fischman (Auburn University)

Title: The Scientific Publishing Game: Perspectives from an Author, Reviewer, and Editor

Abstract: This presentation will cover topics such as what journal editors and peer-reviewers expect authors to include in each section of a manuscript (i.e., introduction, methods, results, discussion) and how to respond to editors' and reviewers' comments.

Date: Thursday, 29 May 2009

Place: USAARL Lecture Room

Speaker: Dr. Paula Henry (U.S. Army Research Laboratory)

Title: Perception of Auditory Motion

Abstract: Soldiers make decisions based on the perception of ambient sounds that are stationary or moving. The localization of stationary sounds is accomplished through comparisons of time and intensity received by the two ears. The identification of the movement of a sound is thought to be accomplished through multiple comparisons of the acoustics of the sounds received by the two ears over time with the possibility that there is a specialized movement detector. The

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perception of moving sound sources will be discussed along with results of a research study examining the perception of movement in an auditory stimulus that travels along a straight path with and without reverberation.

Date: Thursday, 4 June 2009

Place: USAARL Lecture Room

Speaker: Dr. Tim Walikko and Ms. Lee Ann Young (Applied Research Associates, Inc.)

Title: Breacher Injury Study

Abstract: The Breacher Injury Study was a multi-organizational research program designed to determine whether breachers are at risk of neurological injury as a consequence of repeated low-level blast exposures. In this study, students and instructors participating in the two, 2-week basic breacher training course taught through the USMC Weapons Training Battalion Dynamic Entry School underwent rigorous neuro-behavioral testing, blood toxin screening, vestibular and auditory testing, and four modalities of neuro-imaging the weekends before and after the 2-week training course. Data from the first weekend provides a baseline condition for the test subjects, against which the post-training results can be measured. Shorter, computerized neuro-behavioral testing and limited vestibular/auditory assessments were performed during the 2-week training period, thus facilitating detection of neurological and auditory changes as they occur. To facilitate correlation between the human response measurements and the blast loading environment, the breachers and instructors were each instrumented with four pressure gages, two on their helmets and two on their shoulders, and a 3-degree-of freedom inertial cube. The environment was also monitored for lead toxins, and free-field pressure and heat flux gages supplemented the personnel-borne instrumentation. This presentation will highlight the results of the Breacher Injury Study and provide insight into the effects of repeated blast exposures.

Date: Monday, 11 June 2009

Place: USAARL Lecture Room

Speaker: Dr. Tarun Goswami (Wright State University)

Title: Overview of Orthopaedic Biomedical Research

Abstract: This presentation will focus on the orthopaedic biomedical research being conducted at Wright State University in the areas of clinical and design and development orthopaedic biomedicine. Biomechanical evaluation of constructs is conducted to facilitate clinical plans whereas design and development aspects include new devices, biomaterials and modeling. Spinal devices, outcome measures and instrumentations are studied more fully so that spinal injury can be understood, risk factors determined to develop a plan for interventions, if need be, for active service, or labor intensive personnel. Work conducted includes new innovations in the total joint replacements, trauma instrumentations, and other medical devices. New device designs also include fitting clinically viable cross-sections, optimizing the designs and finite element analyses. Wear in the implanted devices continues to be a major reason for the pain/infection and revision surgeries. New models are in development to predict wear rates and characterize roughness development in liners at near nanometer scale (molecular level) so that mechanisms and kinetics understood more fully.

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Date: Monday, 29 June 2009

Place: USAARL Lecture Room

Speaker: Ms. Ashley Willobee (Andrews Institute)

Title: Andrews Institute: A Leader in Musculoskeletal Surgery, Treatment, and Research

Abstract: Baptist Health Care in Pensacola has built a world class institute for orthopaedics and sports medicine in Northwest Florida, with the leadership and reputation of nationally and internationally renowned orthopedic surgeon James Andrews, MD. The creation of the Andrews Institute has secured Northwest Florida as a cradle for musculoskeletal treatments and research. The Institute is comprised of several divisions including: Multi-specialty Ambulatory Surgery Center, Outpatient Rehabilitation, Diagnostic Imaging Center, Athletic Performance Center, a Research and Education Institute, and a multispecialty office park for physicians.

The Institute is located on property contiguous to the Gulf Breeze Hospital in Gulf Breeze, Santa Rosa County. Gulf Breeze Hospital has the distinction of leading the nation in patient satisfaction for more than nine consecutive years. The Andrews Institute has attracted national and international attention to the area for its superior medical care in orthopedics and research, while contributing to the local economy. The Institute has created 150 new jobs, with nearly \$10 million in wages, in the highly educated and technical fields of musculoskeletal research and health care. The combined impact of the patient clientele and employment opportunities related to the Institute further enhances Northwest Florida's ability to create and maintain an environment for positive growth while creating a reputation for world class medical care.

Our mission is to provide the best medical care for the musculoskeletal system through orthopaedics and sports medicine, utilizing innovative clinical and surgical technologies, and to improve patient care through research and education, emphasizing prevention.

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Research Support

Flight Activities

During FY09, the Flight Systems Branch (FSB) personnel included one Department of the Army Civilian Supervisory Research Helicopter Instructor Pilot, one Army Medical Department (AMEDD) 67J officer (0-3) Flight Operations Officer, and one Flight Surgeon.

Assigned assets in FY09 were:

JUH-60A: 88-26069 Black Hawk helicopter

NUH-60FS: 85-00009 UH-60 Aeromedical/Environmental Research flight simulator

*HH-60M: 20134 and 27001 Advanced Aeromedical Evacuation Helicopter (Assigned to UH-60 PMO)

Flight hours in the USAARL aircraft/simulator in FY09 were:

Rotary-wing flight, JUH-60A = 290 hours

Simulator flight = 390 hours

Simulator peripherals utilization other than flight = 980 hours

Note: Simulator peripheral use included VIP tours; research support set-up process; test runs; software load demonstrations; fit, form, and equipment function checks; test preparation; static cockpit demonstrations; and device capabilities presentations.

Summary Highlights

The FSB completed a very productive research support year completing several capstone projects. The effective utilization of our research assets and aviators provided support to all of the internal research divisions and an ever growing number of external organizations. FSB's support to the flight execution and final completion of the Modafinil/Dextroamphetamine Sustained Operations Study alone was a major accomplishment. FSB's support of this study proved a major challenge given the short supply of research pilots. Over 160 aircraft hours and 40 simulator hours enduring 7 total months of data collection. Of note this mission required flying in essence "single-pilot" at night (unaided) as the research subject pilots were severely sleep-deprived. Another capstone project was the very aggressive support schedule of the UAS Air Controller study, completing this study early in the first quarter, flying over 48 subjects in only 2 weeks. On the heels of the UAS study, FSB then launched one of the most time-intensive simulator research protocols to be flown in several years. FSB co-authored, coordinated, and then executed the Speech Intelligibility Hearing Study by flying over 93 hours in the NUH-60FS Aeromedical Research flight simulator. The Speech Intelligibility study was quickly followed by another simulator intensive research protocol, the Spatial Disorientation and Cognition Study.

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This elaborate study required one research pilot to fly and induce spatial disorienting conditions while the researchers measured cognitive function data on the study-pilot. FSB flew over 63 hours in the simulator in support of this study. Finally, in FY09, FSB successfully completed the installation and initial data collection in support of the Defense Safety Oversight Council's "Enhancing Pilot Situational Awareness" Study in our JUH-60A research Black Hawk. Of note, this project which was completely funded by the Defense Safety Oversight Committee (DSOC), took over 24 months to coordinate and netted a \$140,000 navigation system upgrade to our aircraft.

Of all the great accomplishments of this past calendar year, our greatest has been that FSB pilots have continued our phenomenal accident and incident free safety and performance record. Our pilots have maintained qualifications in all models of the Black Hawk (JUH-60A, HH-60L, HH-60M) and currency in all modes of flight; day, night, weather, and night-vision-goggle. Given these capabilities and qualifications USAARL FSB is quickly becoming one of the most sought after and respected aeromedical research organizations in the world.

The JUH-60 Black Hawk was used in the following research and external support projects.

- a. Modafinil in-flight research protocol determining if pilot performance and alertness were affected by the use of modafinil, dexedrine, or a placebo (June 2008 to January 2009).
- b. UAS Air Controller Study evaluating the effects of motion on UAS airborne control (December 2008 to January 2009).
- c. Multiple local dignitary and VIP support missions were flown in accordance with the USAARL and U.S. Army Aviation Center of Excellence (USAACE) MOA.
- d. DSOC's Enhancing Pilot Situational Awareness Study (commenced November 2009)
- e. Data collection and noise surveys were conducted for Sound Innovations in support of their continued development of the active noise cancellation ear-plugs.
- f. Initial noise survey flights in support of Acoustics' Noise measurement study of all US Army helicopters.
- g. In-flight electromagnetic interference (EMI) and human factors assessments of dozens of PMI in support of USAARL's ACE Branch (AR 40-61).

Note: USAARL's in-flight evaluation of PMI utilizing the JUH-60A Black Hawk helicopter expanded to include assistance to PMO Utility in performing a design review of the interior modular MEDEVAC system (IMMS) and SKEDCO litter straps (January 2009). The ACE Branch contributed greatly to the Global War on Terror (GWOT) making significant accomplishments during FY09 in approving the needed PMI. The UH-60 fleet-wide Airworthiness Release (AWR 1330R Rev 13) for MEDEVAC UH-60A/L and Search and Rescue (SAR) configured HH-60L/M Helicopters.

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Items tested and AWR approved in FY09 are:

- a. Impact 754/754M ventilator
- b. Alaris MedSystem III infusion pump
- c. BCI 3303GR pulse oximeter
- d. Impact Model 326/326M portable suction
- e. Thermogear Chillbuster, model 80001
- f. Welch Allyn Propaq 106EL/206EL
- g. Nonin 9550 Onyx II finger pulse oximeter
- h. Verathon GlideScope Ranger video laryngoscope
- i. U.S. Army decontaminable litter
- j. Enflow Fluid Warmer, models 100 &120
- k. ZOLL Power infuser (100B-3A)
- l. Welch Allyn Propaq LT
- m. Versamed iVent 201
- n. SeQual Eclipse, Model 1000A
- o. Masimo RAD 7 pulse oximeter
- p. Masimo RAD 57 pulse oximeter
- q. Nonin pulse oximeter, model 2500
- r. AutoMedx SAVe ventilator (600x10)
- s. Philips MRx monitor/defibrillator
- t. Viasys LTV 1200 ventilator
- u. ZOLL CCT monitor/defibrillator
- v. ZOLL 1x1 battery charger
- w. Philips X2 physiological monitor
- x. Codman Express ICP monitor
- y. Sorenson ambIt MARAA pump
- z. Sorenson ambIt standard PCA pump

The USAARL's continued its efforts in support of A-PM MEDEVAC by evaluating the ABOGS for the HH-60M. This technical evaluation required HH-60M flights to altitudes of 14,000 feet and very challenging engineering configurations in order to measure the system's performance. Also, USAARL the FSB and the ACE Branch supported A-PM MEDEVAC with fit-form-function testing of the IMMS.

Also of note, FY09 marked the inaugural PMI testing aboard the HH-60M aircraft for the aeromedical evacuation community. This testing expanded AWR 1330 to include compatibility of the new "HH-Mike" model, as well as initial altitude testing and certification of the AMOGS.

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NUH-60FS full-motion Aeromedical/Environmental Black Hawk Flight Simulator was used in numerous research projects as follows:

- a. Successful completion of the Speech Intelligibility Study in support of the Acoustics Research Branch. Over 93 flight hours and 180 man-hours were dedicated to this study.
- b. Assessments were made in the research simulator for the Acoustics Research Branch for determining the noise volume attainable for replicating the actual UH-60 aircraft noise pattern.
- c. Spatial-Disorientation and Cognition Study which flew over 63 hours in the NUH60FS Aeromedical flight simulator and another 100 research pilot man-hours dedicated to this study.
- d. Multiple research tours were conducted for researchers and their colleagues to demonstrate the capability of the world's only environmentally controlled full-motion simulator. Organizations such as the Program Executive Office for Simulation, Training, and Instrumentation (PEO STRI), USAACE headquarters, Concepts and Requirements Directorate (CRD), several foreign dignitaries, and multiple colleges and universities participated in tours.
- e. TSAS-Lite demonstrations continued during FY09. Utilizing the flight simulator for tactile demonstrations enabled the research pilot to demonstrate the dust landing characteristics and hazards and actively demonstrate brownout solutions. Approximately 50 simulation demonstrations with TSAS took place in FY09.
- f. The Aviation Technical Test Center (ATTC), USAACE, DOS, Director of Evaluation and Standardization (DES), Army Training Modernization Directorate (ATMD)/G-3, E Company 1-212th Flight School XXI, the Foreign Officer Liaison offices, MEDEVAC Proprietary, as well as the students of the U.S. Army Flight Surgeons' Course and Aviation Safety Officers' Course utilized the research simulator for training on a no-cost basis.
- g. USAARL flight crews maintained aircraft and instrument proficiency utilizing the simulator. Two external Annual Proficiency Evaluations (APART) were conducted for Fort Rucker agencies in accordance with the aircraft MOA. USAARL continued its support to the 110th Aviation Brigade as a back-up simulator for support of Flight School XXI during times when USAACE simulators have experienced maintenance difficulties.
- h. Mr. John Ramiccio, panel member for the Aeromedical Consultation Panel, continues to utilize the aeromedical flight simulator to conduct aeromedical flight assessments for aviators in the process of obtaining aeromedical waivers for continuing aviation service.

Maintenance of the JUH-60A Research Helicopter

The MOA with USAACE/Aviation Center Logistics Command (ACLC)/G-3 remains strong and has proven to be beneficial to all organizations involved. A 100-hour phase inspection was completed in the second quarter of FY09. This phase inspection, the associated labor, and aircraft parts netted a cost-avoidance of nearly \$750,000. Replacement of both fuel cells also occurred this FY. Other "no-cost" upgrades were coordinated by the branch:

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- a. Blue Force tracker and Electronic Digital kneeboard.
- b. Aircrew Wireless Intercom System.
- c. Garmin 530W with Helicopter Traffic Avoidance Radar Warning System (H-TAWS), Global Terrain Data Base, NEXRAD weather radar, storm scope, and Wide Area Augmentation System (WAAS) certified instrument flight rules (IFR) Global Positioning System (GPS) landing capability.

Maintenance Management of the NUH-60 Research Simulator

The simulator maintenance support was outstanding during FY09. Two major systems were upgraded: the newest version of the Common Missile Warning Systems was installed, an approximate \$15,000 improvement to simulator capabilities and the installation of the latest version of the transponder, the APX-118, an approximate \$20,000 improvement to the device. Both of these systems integration upgrades were negotiated as “no-cost” to the lab.

In preparation for supporting brownout and spatial disorientation for WPHD and NASA, FSB received the Army’s newest brownout model for our device. This unique system is being field tested aboard our simulator in FY09 to FY10. Background: In response to the functional needs statement written by Mr. John Ramiccio and Dr. Arthur Estrada, Utility PM for Simulations contracted the development of an improved dust model to aid pilot training; tactics, training, and procedures (TTP) development; and new solutions test and evaluation for the ever growing threat to Army aviation’s operations in degraded visual environments. This system is being installed and tested in our flight simulator and will serve as the most advanced brownout simulations flight model in the world.

New scheduled upgrades at no-cost to USAARL for FY10 include new digital projection monitors and projectors, and brand new XIG computers that will enhance visual projections and incorporate the Afghanistan and Iraq databases.

Projected annual simulator cost increases for the past two years have been diverted through intensive contract negotiation and a positive relationship building effort with the Program Executive Office for Simulation, Training, and Instrumentation (PEOSTRI). In response to allowing student training for flight school XXI, staff officer support, and Annual Proficiency Evaluations (APART) support, the delta in the annual cost increase has been absorbed by PEOSTRI, rather than being charged to USAARL. This is over a \$6000 per month savings.

Standardization/Aircrew Training Program

A major accomplishment this year for FSB was Mr. John Ramiccio being assigned duties as the MEDCOM Standardization Officer. This assignment places Mr. Ramiccio in the position to provide MEDEVAC and Army aviation Standardization consultation directly to the Office of the Surgeon General (OTSG).

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All research pilots participated in the annual Aircrew Coordination Training (Enhanced) and scored 100% on all written and performance evaluations. The FSB team provided Aircrew Management training and records support for several Army flight surgeons, active duty support pilots, Flight Activity Categories (FAC) 3 aviators, and Army civilians. The FSB was also a member of the USAARL Safety and Standardization Council during FY09.

Subject Matter Expertise Efforts

FSB's single research instructor pilot serves a variety of external organizations as an aviation and aeromedical subject matter expert.

- a. NATO HFM-190 "Oxygen Solutions for Unpressurized Aircraft Operating below 18,000 feet" (Hypoxia prevention).
- b. NATO HFM-182 "Safe-Ride Standards for UAS-Medical Evacuation."
- c. Army Night-Vision Labs - Advanced Distributed Aperture System (ADAS)/OPUL.
- d. NASA-AMES Brownout Symbology Set Project (BOSS).
- e. UAS-Board of Directors Stake Holder panel.
- f. A-PM MEDEVAC HH-60M model AMOGS and AWR certifications.
- g. MEDCOM Standardization assistance to the Clearwater Army Reserves providing pilot training.

Training Accomplishments

- a. Mr. John Ramiccio completed the HH-60M aircraft qualification and subsequent instructor pilot progression. It should be noted that this qualification was accomplished at "no-cost" to USAARL and concurrent to accomplishing ACE Branch support.
- b. Mr. Ramiccio completed annual Contracting Officer's Representative (COR) training.
- c. Mr. Ramiccio successfully completed the Government Flight Representative (GFR) Course.
- d. Mr. Ramiccio attended MANPRINT Officer's refresher training.
- e. CPT Michael Crivello successfully completed the US Army Aviation Safety Officer's Course.

Internal Research Support

- a. Co-authored, planned, and executed the modafinil and dexedrine in-flight sustained operations study from June 2008 to January 2009. The FSB staff flew over 160 hours and managed 40 hour flight simulator and aircraft flight operations in support of the protocol.
- b. Conducted multiple TSAS demonstrations in support of the WPHD.
- c. Provided spatial disorientation SME to the WPHD in support of a proposal on spatial disorientation effects and cognition and then successfully executed the study.
- d. Designed, co-authored, and executed the Speech Intelligibility study in support to SRD.

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- e. Coordinated and executed several airworthiness cycles both in the local area and at Eglin AFB, resulting in the addition of the HH-60M to AWR 1330R certifying 26 new PMI items in support of the ACE Branch.
- f. Supported multiple ACE Branch protocols to include inaugural HH-60M testing at Eglin AFB, and HH-60M AMOGS and initial vibratory analysis of the HH-60M.
- g. Provided research pilot/SME input regarding ADAS, OPUL, and several night vision goggle (NVG) configurations for the Visual Sciences Branch.
- h. Chief, FSB served as a member of the USAARL Science Review Committee.
- i. Provided comprehensive review as members of a Small Business Innovation Research (SBIR) project in support of WPHD.
- j. Provided open access to the UH-60FS during holidays to demonstrate and familiarize research personnel with the capabilities of the simulator for research support.

External Consultations and Subject Matter Expertise Support

- a. USAARL research pilots continue to serve as members of the Office of the Secretary Defense (OSD), Defense Safety Oversight Council (DSCOC) and have contributed to reducing controlled flight in terrain (CFIT) accidents, improving seat and seat restraints systems, and brownout/degraded visual environment solutions.
- b. Panel member for NATO HFM RTG 184, “Safe-Ride Standards for UAS MEDEVAC.”
- c. Panel member for HFM-190 “Oxygen Solutions for Unpressurized Aircraft.”
- d. Attended multiple briefings at CRD providing feedback on the TOPOWL HMD system, and a variety of brownout solution programs by industry.
- e. Member of the MEDCOM and USAARL Aviation Safety and Standardization Council.
- f. Provided Aviation Center Logistics Command assistance in ferrying multiple UH-60A/M aircraft to and from rework maintenance facilities in Corpus Christi, TX and Savannah, GA.
- g. In accordance with the USAACE, ACLC, and USAARL MOA provided protocol, training, and ferry missions support.
- h. Attended several U.S. Army Aviation and Missile Command (AMCOM) Airworthiness Certification Coordination teleconference.
- i. Member of the AMEDD Evacuation Integrated Concept Team (ICT).
- j. Supported USAMRMC by attending the Association of the U.S. Army (AUSA) National Conference and providing TSAS demonstrations.
- k. Provided training support and standardization expertise to MEDEVAC proponency.

Fiscal Success Summary

- a. No-cost Aircraft Upgrades:
Garmin 530W = \$140,000
Blue Force Tracker and EDM Kneeboard = \$30,000
Aircrew Wireless Intercom = \$25,000

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*MOA Cost Avoidance in FY09 estimated at \$750,000

b. No-cost Simulator Upgrades:

APX-118 Transponder = approximately \$20,000

Common missile warning system = approximately \$15,000

New David Clarke headsets = \$500

*Through effective contract management efforts have managed to defer or avoid simulator cost increases totaling nearly \$6000/month.

c. As a result of attending the Army Aviation Association of American Conference (AAAA), FSB was able to obtain at no-cost one MILTOPE Aviation Mission Planning Computer for flight planning, saving the laboratory several thousands of dollars.

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Technology Transfer

USAARL maintained an active technology transfer program in FY09 through distribution of its technical reports, publication in the open literature, presentations to military and civilian audiences, execution of Cooperative Research and Development Agreements (CRADAs) and Material Transfer Agreements (MTAs), and protection of intellectual property through invention disclosures and patenting.

USAARL is a member of the Federal Laboratory Consortium as well as an active community member and participant in technology transfer activities within the state of Alabama. Examples of USAARL's contributions to the locality include the loan of excess research equipment to regional universities under MTAs and donation of excess computers to local schools under Education Partnership Agreements (EPAs).

USAARL utilized the Oak Ridge Institute for Science and Education (ORISE) Internship Program, an EPA program, to place thirteen interns in research projects.

A Memorandum of Understanding (MOU) providing broad cooperative guidelines for collaborative research activities was signed by USAARL and the Auburn University. Specific research projects will be documented in CRADAs.

A patent was granted for the USAARL invention "Airborne Visibility Indicator." One invention disclosure was filed.

Researchers addressed local civic organizations and conducted numerous USAARL tours. These tours were highlighted by a Laboratory overview followed by in-depth discussions of the research programs.

In FY09, one of USAARL's strategic goals was to influence Army combat and materiel developers. The objective was to promote USAARL's capability to positively impact and improve the products made by these developers. In order to achieve this, USAARL employed the strategy of teaming, through CRADAs, with materiel developers such as Active Signal Technologies, Inc. to develop a NIS for use in high noise environments. Partnering with this small business entity, USAARL investigators were instrumental in the early research and refinement of an ultrasound stethoscope, capable of conveying clinically-useful pulse "sounds" in high-noise environments, such as a helicopter. The outreach of this medical device extends far beyond the aviation community. Emergency medical technicians, firefighters, and other medical professionals who need to hear in noisy environments will benefit from this as well.

USAARL partnered with industry to evaluate and enhance medical equipment for use on MEDEVAC aircraft, to collaborate on visual performance issues, and to investigate the effect of helmet configuration on the injury incidence rate. The exchange of technical information and testing of materiel furthered the development of improved life support and personnel protective devices, systems and components for military medical purposes.

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USAARL's ACE Program was identified by the USATRANSCOM Surgeon, as well as the Director of USAMRMC, as the Joint Center of Excellence for Operational Test and Evaluation of Medical Equipment for use on land, sea, and air. ACE CRADAs were funded by collaborators in FY09 for a total of \$111,454.63.

USAARL Cooperative Research and Development Agreement/Material Transfer Agreement partners in FY09 were:

Active Signal Technologies, Inc. to provide a mechanism for scientists of USAARL and the company to collaborate on final prototype evaluation of a NIS for high noise environments.

BAE Systems for collaboration on basic and applied research into optical, visual, acoustical, auditory, and biodynamic issues with head-borne systems.

Bio-Behavior Analysis Systems to exchange data and technical expertise in the study of maintenance of alertness.

CANVS Corporation for collaborative research and development of colored image intensifier components and systems.

CareFusion (formerly Viasys Healthcare/Pulmonetic Systems) for collaborative research, development, test and evaluation on medical devices for use on medical and casualty evacuation aircraft.

Communication and Ear Protection, Inc. for collaboration in research, development, test and evaluation of hearing protective devices.

EyeCom Corporation/Washoe Sleep Disorders Center for cooperative testing and evaluation of an SBIR-developed eye tracking system capable of integrating into a physiologic monitoring system to assess for and predict potential operational performance failures.

Florida Institute for Human and Machine Cognition for exchange of data and technical expertise in a study of the use of human-centered novel display technologies in aviation.

Gaumard Scientific Co., Inc. for collaborative research, development, test and evaluation on medical devices for use on medical and casualty evacuation aircraft.

Gentex Corporation for collaboration on research and development of testing techniques of aircraft safety equipment.

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***Georgia Institute of Technology* to provide a mechanism for USAARL scientists to loan equipment and software which will facilitate their research into bone conduction communications and to mentor students involved in this research.

Hospira, Inc. for collaborative research, development, test and evaluation on medical devices for use on medical and casualty evacuation aircraft.

Insight Technology, Inc. for evaluation of the Panoramic Night Vision Goggles (PNVG) system.

ITT Defense for collaboration in visual testing of image intensifier components and systems.

Legacy Clinical Research and Technology Center to provide a mechanism for transfer of a custom built short-arm centrifuge and computer peripherals to the USAARL.

Masimo Corporation for collaborative research, development, test and evaluation on medical devices for use on medical and casualty evacuation aircraft.

Medical Education Technologies, Inc. for collaborative research, development, test and evaluation on medical devices for use on medical and casualty evacuation aircraft.

Natus Medical, Inc. for loan of the Navigator Pro AEP software Version 7.0 to the USAARL for data collection.

NavigSys Innovations, Inc for evaluation of the efficacy of the TSAS belt over moving targets.

Nonin Medical, Inc. for cooperative research, development, test and evaluation of medical devices for use on medical and casualty evacuation helicopters.

Nonin Medical, Inc. (2) for customer-funded laboratory and flight testing of the Onyx II Model 9550 Pulse Oximeter for use on U.S. MEDEVAC helicopters.

Oregon Aero, Inc. for collaboration on testing of HGU-56/P-specific Oregon Aero helmet liners and components for use in the Army flight helmet.

Phillips Medical Systems, North America for collaborative research, development, test and evaluation on medical devices for use on medical and casualty evacuation aircraft.

Physio-Control, Inc. for collaborative research, development, test and evaluation on medical devices for use on medical and casualty evacuation aircraft.

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Sarnoff Corporation for evaluation of In-the-Ear Biopotential Electrodes and associated cables during the study of an SBIR-developed eye tracking system.

Skedco, Inc. for evaluation of the Skedco Universal Litter Tie Down Strap and Patient Litter Strap for use on medical and casualty evacuation aircraft.

***Sound Innovations* (CRADA and MTA) for in-flight comparative testing of the ANR Communication Earplug (ACE™) with other talk-through, sound localization, and impulse suppression devices.

Thornhill Research, Inc. for cooperative research, development, test and evaluation of medical devices for use on medical and casualty evacuation helicopters.

***University of Arkansas* for loan of excess scientific equipment to the university for use in a research project involving data collection and analysis related to head-supported mass and the H-reflex.

University of Florida Institute for Advanced Study (CRADA and MTA) for collaborative basic and applied research in evaluating hearing processes, hearing protective devices and speech communication.

***Utah State University* for collaborative basic and applied research in evaluating hearing processes, hearing protective devices and speech communication.

Verathon Medical, Inc. for collaborative research, development, test and evaluation on medical devices for use on medical and casualty evacuation aircraft.

Versamed, Inc. for collaborative research, development, test and evaluation on medical devices for use on medical and casualty evacuation aircraft.

Wayne State University for loan by the USAARL to the College of Engineering a FOCUS head form.

Welch-Allyn, Inc. for collaborative research, development, test and evaluation on medical devices for use on medical and casualty evacuation aircraft.

USAARL/Applied Research Associates, Inc./Duke University/T.R.U.E. Research Foundation to develop a transfer function and numerical model which translates the helmet-mounted sensor response data to head-centered biomechanical responses in support of the DoD Congressionally Directed Medical Research Program's (CDMRP's) Psychological Health/Traumatic Brain Injury (PH/TBI) Research Program Award for the proposal PT075837, entitled "Helmet Sensor-Transfer Function and Model Development."

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USAARL/ClinVest/ T.R.U.E. Research Foundation (CRADA and 2 MTAs) to test the hypothesis that mild to moderate hypoxic hypoxia reversibly uncovers neurological deficits in individuals who have experienced mild traumatic brain injury and who appear asymptomatic when breathing air with normal sea level concentrations of oxygen in support of the DoD PH/TBI Research Program of the Office of the CDMRP, TBI Investigator-Initiated Research Award proposal PT075175 entitled “The Effects of Hypoxia on Cognitive Function in Aviators and Complex System Operators that have had a Mild Traumatic Brain Injury.”

USAARL/T.R.U.E. Research Foundation in support of the CDMRP’s PH/TBI Research Program Award for the proposal PT075813, “Auditory, Vestibular and Cognitive Effects Due to Repeated Blast Exposure on the Warfighter.”

USAARL/T.R.U.E. Research Foundation in support of the USAMRMC Intramural War Supplemental Program Award for the proposal CWS_08_R3_110, ”Auditory, Vestibular and Cognitive Effects from Repeated Blast.”

USAARL/T.R.U.E. Research Foundation/SUNY in support of the USAMRMC Intramural War Supplemental Program Award for the proposal CWS_08_R2_290, “Determination of novel Strategies for Hastening Corneal Wound Healing and Reducing Tissue Inflammation.”

Twin Star Medical, Inc. for collaborative research, development, test and evaluation on medical devices for use on medical and casualty evacuation aircraft.

Zoll Medical Corporation for collaborative research, development, test and evaluation on medical devices for use on medical and casualty evacuation aircraft.

**CRADA/MTA includes loan of excess research equipment to these institutions.

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Science Information Center

The Science Information Center (SIC) library provided the information necessary to support the research performed at USAARL and disseminated scientific information to requestors worldwide. It also supported the staffs of Lyster Clinic, the USAAMA, and the U.S. Army School of Aviation Medicine including the Flight Surgeon Courses held at Fort Rucker throughout the year. The library holdings are believed to comprise the most comprehensive aviation medicine collection in this part of the country. Additionally, the SIC is a member of a national library consortium that, through interlibrary loans, exponentially expands each member's resources at minimal cost to each member.

The Office of the Writer-Editor contributed to the quantity and quality of publications to include USAARL technical reports, open literature publications, and public relations brochures and pamphlets created to describe the research conducted by the USAARL scientists and engineers; served as grants administrator and contributed toward group efforts to secure several federal research grants; and consolidated and expanded a public relations program aimed at marketing USAARL's unique talents and assets.

The Office of the Research and Technology Applications (ORTA) administered USAARL's technology transfer program.

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Resources Management

Program funding for FY09/FY10 (dollars in thousands):

	FY09	FY10
6.1 Basic Research	165	TBD
6.2 Applied Research	5,238	7,785
6.3 Advanced Technology Development	2,332	1,868
6.4 Demonstration and Validation	652	800
6.5 Engineering and Manufacture Development	300	0
Other	7,578	1,553
TOTAL	\$16,265	\$12,006

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Training

The USAARL's training program for FY09 included 76 training experiences. Training encompassed supervisory development training, training required by the Army for our Warfighters, and training to help employees perform more effectively in their current positions.

The following Laboratory-wide training was conducted for all USAARL personnel:

- October: Equal Opportunity (EO) Training – Consideration of Others
Cold Weather Training
Military Occupation Specialties (MOS) Training
Noncommissioned Officer Development Program (NCODP) – Education
- November: Army Substance Abuse Training
Ethics Training (online)
Sergeant's Time Training (STT) – Ground Guiding a Vehicle
NCODP
MOS Training
- December: Annual Security Refresher Training
STT
NCODP
MOS Training
Face to Face Ethics Training
Ethics Training Online
- January: STT – Commissioning Programs
EO Training
MOS Training
STT – Awards
NCOPD – Noncommissioned Officer Evaluation Reports (NCOER) Part I
Leader's Reaction Course (LRC)
- February: STT – Basic Rifle Marksmanship (BRM) Part I
Family Action Plan
NCOPD – NCOER Part I
MOS Training
STT – BRM Part II

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- March: NCOPD – Counseling
Army Substance Abuse Program (ASAP) Training
STT –Tactical Combat Casualty Care (TC3)
MOS Training
NCOPD – Roles and Responsibilities of a Noncommissioned Officer (NCO)
STT – BRM Part III
Suicide Prevention Training Part I
Suicide Prevention Training Part II
Personally Identifiable Information Handling, Removable Media Handling,
Safe Home Computing, Anti-Phishing, G3 Security
EO Training
- April: Sexual Assault Response and Prevention
STT – Advanced Rifle Marksmanship (ARM) Training
Consideration of Others (CO2) Training
MOS Training
Military Operations on Urban Terrain (MOUT) Part I
NCOPD – Troop Leading Procedures
- May: Hot Weather Training
STT - Awards
ASAP
STT – Mouth to Mouth Resuscitation/Evaluate a Casualty
STT – Checkpoint Ops/Conduct a Vehicle Search
BRM Part IV
MOS Training
- June: STT – React to Direct/Indirect Fire
Round Robin Training
Situational Training Exercise (STX)
NCOPD – Courses of Action
Employee and Supervisor Safety Training
- July: MOS Training
STT – Hazardous Waste Management
Prevention of Sexual Harassment (POSH) Training
STT – Nuclear, Biological, and Chemical (NBC) Overview Part I
NCOPD – Personnel Inspections
STT – NBC Overview Part II
- August: NBC Chamber
STT – Set-up and Operate SINCGARS
NCOPD – Decision Making Process
STT – Team Building
ASAP
STT – Occupy a Forward Operating Base (FOB)

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September: Financial Readiness
NCOPD – Family Care Plan/Family Readiness Group
NCOPD – Awards Writing
ARM Training Part II
STT – Preventative Medicine Measures

Dates varied by individual for the following annual mandatory training requirements:

Information Assurance Awareness Training
Anti-Terrorism Training (online)
Safety Stand-down Day
POSH Training (online)
Health Insurance Portability and Accountability Act (HIPAA) Refresher Training (online)

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Computer Information

Network Infrastructure Improvements

A classified open storage area was accredited for housing the Secret Internet Protocol Router Network (SIPRNET) server, network switch and Tactical Local Area Network Encryption (TACLANE) device, allowing for terminal connectivity throughout the JTAPIC Branch in support of the JTAPIC effort.

The USAARL local area network was upgraded to CAT-6 cable in buildings 6901 and 8825 by the Tri-Service Infrastructure Management Program Office (TIMPO).

A Computer Access Card (CAC)-enforced Virtual Private Network (VPN) connection was established, allowing authorized users connectivity to local USAARL servers from anywhere via the world wide web.

Two fully functional video teleconference rooms were installed at USAARL. The primary teleconference room utilizes a MEDNET (Internet Protocol [IP]) connection, while the second teleconference room connects via integrated services digital network (ISDN) lines.

The new Defense Medical Logistics Standard Support (DMLSS) server solution was implemented.

The new Host-Based Security System (HBSS) was implemented with the USAARL server supporting all Fort Rucker AMEDD assets. The system detects and counters, in real-time, against known cyber-threats to the DoD enterprise.

Security Improvements and Upgrades

Credant encryption SW is now installed on all USAARL laptop and desktop personal computers connected to the AMEDD domain.

Wireless Communications

Fifteen Blackberry™ devices are now in use by staff members; the devices provide phone, email, and internet access from one handheld device.

Software Applications

All workstations and laptops have been upgraded to Microsoft Office 2007.

The USAARL website was re-designed to comply with new MEDCOM policies and templates.

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Personnel

As with the majority of government organizations, USAARL has been impacted by downsizing within the Government. Loss of manpower authorizations and requirements, both military and civilian, has deleted critical scientific skills and intensified the disparity between required and authorized strength levels. In order to meet continuing mission demands in light of these staffing limitations, in addition to the work force described below, USAARL had a monthly average of 14 over-hires, 12 terms and 38 non-table of distribution and allowances (TDA) personnel during FY09. Non-TDA personnel include nine Student Temporary Employment Program (STEP) personnel, on-site research and research support contractor personnel, exchange officers and casual officers.

Required strength was 28 officers, 1 warrant officer, 33 enlisted, and 66 civilians for a total of 128 requirements. Authorized were 17 officers, 1 warrant officer, 27 enlisted, and 40 civilians for a total authorized strength of 85. The average assigned strength was 10 officers, 1 warrant officer, 25 enlisted, and 74 civilians for an average assigned strength of 110.

USAARL employs a highly skilled and trained work force with 70% of assigned employees possessing higher education degrees. The types of degrees held by Laboratory employees as of 30 September 2009 were: 6 M.D.s, 19 Ph.D.s, 1 Au.D., 13 Masters, 28 Bachelors, and 9 Associate degrees.

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Equal Employment Opportunity Program

The USAARL Equal Employment Opportunity (EEO) Coordinator completed quarterly EEO reports for the USAARL Commander for submission to the Commander, USAACE, Fort Rucker, AL, through the Fort Rucker EEO. These reports identified the USAARL's EEO objectives, actions to be taken to meet objectives, and accomplishments in meeting the objectives through hiring actions, promotions, details or temporary promotions, awards, training, and supervisors' support of the EEO program.

All Department of the Army civilian employees and supervisors of civilian employees who required training in 2009, completed the Department of Army's POSH and No Fear Act training courses. Reports were completed for submission to the Fort Rucker EEO Office.

Primary and alternate representatives, appointed for two-year terms, served on the Fort Rucker Special Emphasis Program committee (SEPC). Representatives participated in the Fort Rucker Women's History Month observance.

The USAARL EEO Coordinator served on the Fort Rucker Dr. Martin Luther King, Jr. Commemorative Program planning committee.

The USAARL EEO coordinator, EO Leaders, and SEPC Representatives coordinated and sponsored another very successful, post-wide, Black History Month blood drive and health fair, held in the Lecture Room.

The USAARL EEO coordinator, Equal Opportunity (EO) leaders, and SEPC representatives coordinated and sponsored a well attended Women's History Month Program in March in the Lecture Room.

One USAARL civilian employee is a Department of Army certified EEO Counselor.

African-American or Black Civilian Employees: As of 30 September 2009, USAARL employed 10 African-American or Black civilian employees (six females and four males), for a representation of 9% of civilian employees. One African-American or Black employee received an "A" performance evaluation with a pay for performance and six received a "B" performance evaluation with a pay for performance.

Hispanic Civilian Employees: USAARL employed two Hispanic employees (zero females and two males), a representation of 2% of civilian employees, during FY09. One Hispanic employee received an "A" performance evaluation with a pay for performance and one received a "B" performance evaluation with a pay for performance.

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Female Civilian Employees: During FY09, USAARL employed 33 female employees, a representation of 30% of civilian employees. Fourteen female employees received an “A” performance evaluation with a pay for performance and seven received a “B” performance evaluation with a pay for performance.

Handicapped Civilian Employees: USAARL employed no handicapped employees in FY09.

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Personnel Achievements

Civilian Awards: The following are civilian awards presented during FY09 at USAARL:

32 Pay for Performance A's
29 Pay for Performance B's
2 Invention Awards
10 Time-Off Awards (TOA)
2 On-The-Spot Cash Awards
2 Special Act/Service Awards
1 Recruitment Bonus
1 Certificate of Appreciation
3 Achievement Medals for Civilian Service
2 Commander's Awards for Civilian Service
1 Decoration of Exceptional Civilian Service
7 Length of Service Awards

92 Total Civilian Awards

Civilian Promotions: One white female, IT Specialist (CustSpt/InfoSec), from DJ-2210-02 to DJ-2210-03; One white female, Supv Logistics Management Spec, from DJ-0346-02 to DJ-0346-03; One white male, Electronics Engineer, from DE-0856-02 to DE-0856-03.

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Key Committee/Organization Participation

Acoustical Society of America	Fellow	Dr. W. A. Ahroon
Aerospace Medical Association	Fellow	Dr. J. S. Crowley
Scientific Program Committee	Member	COL R. P. King
	Member	LTC S. E. Phelps
	Member	Dr. J. S. Crowley
	Member	Dr. A. Estrada
	Member	Dr. L. A. Temme
American Academy of Family Practice	Fellow	COL R. P. King
American Academy of Optometry	Fellow	MAJ J. E. Capo-Apone
American Board of Preventive Medicine (ABPM)	Vice Chair, Aerospace Medicine	Dr. J. S. Crowley
Aerospace Medicine Examination Subcommittee of the ABPM	Chairman	Dr. J. S. Crowley
American National Standards Institute	Representative	Dr. W. A. Ahroon
Accredited Standards Committee S3 Bioacoustics	Representative	Dr. W. A. Ahroon
Accredited Standards Committee S12 Noise	Representative	Dr. W. A. Ahroon
Z90.1 Helmet Committee	Member	Mr. B. J. McEntire
S12 Hearing Protection Attenuation and Performance, Working Group 11	Member	Dr. W. A. Ahroon
S12 Measurement of the Noise Attenuation of Active and/or Passive Level Dependent Hearing Protection Devices, Working Group 39	Member	Dr. W. A. Ahroon
S12.7 Methods for Measurement of Impulse Noise, Working Group 32	Member	Dr. W. A. Ahroon

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American Optometric Association	Member	MAJ J. E. Capo-Aponte
American Society for Testing and Materials F30-01, EMS Equipment	Member Member (Non-Voting)	Dr. K. W. Barazanji Mr. R. Eshelman
Army Aviation Medicine Association	Member Member Member Member	COL J. F. McKeon Dr. J. S. Crowley COL R. P. King LTC S. E. Phelps
Association for Psychological Science	Member	Dr. A. M. Kelley
Association for Research in Vision and Ophthalmology (ARVO)	Member	MAJ J. E. Capo-Aponte
Cognitive Science Society	Member	Dr. A. M. Kelley
Department of the Army		
Advanced Night Vision Goggle (ANVG) Program	Member	Dr. W. E. McLean
U. S. Army ALSE Steering Council	Member	Mr. K. Norcutt
Life Support Equipment Steering Committee	Member	Mr. K. Norcutt
Air Warrior System Safety Working Group	Member Assoc. Member Assoc. Member	Mr. K. Norcutt Mr. B. J. McEntire Dr. J. S. Crowley
Joint Aircrew Executive Steering Council	Member	Mr. B. J. McEntire
Team Air Warrior Management Working Group	Member	Mr. K. Norcutt
AH-64 System Safety Working Group	Member	Mr. K. Norcutt
Kiowa Warrior, OH-58D System Safety Working Group	Member	Mr. K. Norcutt
HGU-56/ P Comanche Compatibility Development Program	Member	Mr. C. E. Rash

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Department of the Army (continued)

Military Eye Protection System (MEPS)	Member	Dr. W. E. McLean
Explosion Ordnance Disposal Working Group	Member (Non-Voting)	Dr. W. E. McLean
OMNI 6 ANVIS	Member	Dr. W. E. McLean

Department of Defense

Aircrew Integrated Working Group for Helmet Mounted Displays	Member	Mr. C. E. Rash
Armed Forces Optometric Society	Member	MAJ J. E. Capo-Aponte
Auditory Research Working Group	Member	Dr. W. A. Ahroon
Defense Medical Standardization Board, Test, Evaluation, and Standards Working Group	Member Member Member	Dr. K. W. Barazanji Mr. R. Eshelman Mr. B. Bowers
Global Patient Movement Joint Advisory Board (PMJAB)	Member Member	Dr. K. W. Barazanji Mr. B. Bowers
Hearing Conservation Working Group	Member	Dr. W. A. Ahroon
Joint Cockpit Airbag System Working Group	Member	Mr. B. J. McEntire
Joint Service Aviation Mask (JSAM)	Member (Non-Voting)	Dr. W. E. McLean
Joint Service Display Panel Subpanel on Display Devices	Member	Mr. C. E. Rash
Joint Service General Purpose Mask Working Group	Member (Non-Voting)	Dr. W. E. McLean
Oxygen Standardization Coordinating Group (OSCG)	Member Member	Dr. K. W. Barazanji Mr. B. Bowers
Triservice Aircrew System Sub-Board	Member	Mr. K. Norcutt

U.S. Army Aeromedical Research Laboratory — Fiscal Year 2009

Department of Defense (continued)

Triservice Aviator Helmet Standardization Working Group	Member Member	Mr. K. Norcutt Mr. B. J. McEntire
Triservice Biodynamics Working Group	Chairman	Mr. B. J. McEntire
Triservice Enhanced Noise Reduction (TENOR)	Member Member	Dr. W. A. Ahroon Ms. E. Gordon
Triservice Working Group on Helmet Mounted Displays	Member	Mr. C. E. Rash
Federal Laboratory Consortium	Member	Ms. D. L. Hemphill
Human Factors Society		
Perception and Performance Technical Group	Member	Dr. L. A. Temme
Kansas State University, Human Metabolism Department	Adjunct Professor	CPT M. Dretsch
National Academy of Practice in Optometry	Distinguished Scholar	MAJ J. E. Capo-Aponte
National Board of Examiners in Optometry	Examiner	MAJ J. E. Capo-Aponte
National Hearing Conservation Association	Director of Education	LTC Kristen Casto
National Security Science and Engineering Faculty Fellowship Program	Technical Review Panel Member	Dr. M. R. Lattimore
Society for Judgment and Decision Making	Member	Dr. A. M. Kelley
Society of U.S. Army Flight Surgeons	Member Member Member Member	COL J. F. McKeon Dr. J. S. Crowley COL R. P. King LTC S. E. Phelps
State University of New York (SUNY), State College of Optometry	Adjunct Professor	MAJ J. E. Capo-Aponte

U.S. Army Aeromedical Research Laboratory — Fiscal Year 2009

United States Air Force Aerospace Medicine Residency Advisory Committee	Member	COL J. F. McKeon
University of Texas Medical Branch, Galveston	Adjunct Faculty	COL J. F. McKeon
U.S. Army Medical Research and Materiel Command System Biology Integrated Product Team (IPT)	Member	CPT M. Dretsch
U.S. Army Aviation Warfighting Center Equal Employment Opportunity Committee	Coordinator	Ms. E. Gordon
Fort Rucker Environmental Management Committee	Member	Mr. J. Miller
	Member	Mr. A. Roddy
Fort Rucker Ergonomics Committee	Member	Mr. J. Miller
Fort Rucker Safety and Occupational Health Committee	Member	Mr. J. Miller
Life Support Equipment Steering Committee	Member	Mr. K. Norcutt
Night Vision Goggle Working Group	Member	Dr. W. E. McLean
U.S. Army Aeromedical Consultant Advisory Panel, USAAMC	Member	COL J. F. McKeon
	Member	Dr. J. S. Crowley
	Member	COL R. P. King
	Member	LTC S. E. Phelps
U. S. Army Research Laboratory Cognition and Neuroergonomics Collaborative Technology Alliance, Source Selection Evaluation Board	Member	Dr. A. M. Kelley
U.S. Navy Aerospace Medicine Residency Advisory Committee	Member	COL J. F. McKeon
	Member	Dr. J. S. Crowley
Women in Cognitive Science	Member	Dr. A. M. Kelley

U.S. Army Aeromedical Research Laboratory — Fiscal Year 2009

International Committees

Air and Space Interoperability Council Agile Combat Support Working Group	Army Rep. Army Rep.	Dr. J. S. Crowley Dr. K. W. Barazanji
International Academy of Aviation and Space Medicine Science Review Committee	Academician Member	Dr. J. S. Crowley Dr. J. S. Crowley
International Society of Optical Engineering (SPIE) Helmet Mounted Displays Conference	Display Track Chair Chair	Mr. C. E. Rash Mr. C. E. Rash
International Virtual Reality Conference	Program Committee Member	Dr. B. D. Lawson
NATO Research and Technology Organization Aircrew Integration Working Group	Member	Mr. C. E. Rash
AVT-097, Equipment for Personal Protection Technical Team	Member	Dr. J. S. Crowley
Research and Technology Group Ground Based Spatial Disorientation Training	Army Rep.	Dr. A. Estrada
HFM-084, Unmanned Aerial Vehicle (UAV) Medical Evacuation (MEDEVAC) Operations	Member	Mr. J. G. Ramiccio
HFM-157, Medical Challenges in the Evacuation Chain	Member	Dr. K. W. Barazanji
HFM-162, Rotary Wing Brownout	Member	Dr. A. Estrada
HFM-164, Psychological Aspects of Health Behaviors on Deployed Military Operations	Member	Dr. A. M. Kelley
HFM-171, Psychological and Physical Selection of Military Special Units	Member	Dr. J. S. Crowley
HFM-180, Strategies to Address Recruiting and Retention Issues in the Military	Member	Dr. M. R. Lattimore

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NATO Research and Technology Organization (continued)

HFM-181, Human Performance Enhancement for NATO Military Operations	Member	Dr. J. S. Crowley
HFM-184, Safe Ride Standards for Patient Evacuation using Unmanned Aerial Vehicles	Member	Dr. K. W. Barazanji
HFM-ET-086, Database of Biomechanical Analyses	Member	LTC S. E. Phelps
	Member	Mr. F. T. Brozoski
HFM-ET-082, Requirements for Oxygen Systems for Rotary Wing Aircraft	Member	Mr. J. G. Ramiccio

The Technical Cooperation Program

HUM Subgroup, Technical Panel 7, Human Factors in Aircraft Environments	Army Rep.	Dr. J. S. Crowley
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Miscellaneous Committees

Journal Review Board

Aviation, Space, and Environmental Medicine	Reviewer Reviewer Reviewer Editorial Board Member	Dr. J. S. Crowley Dr. W. E. McLean Dr. B. D. Lawson Dr. J. S. Crowley
International Journal of Human-Computer Interaction	Editorial Review Board Member	Dr. B. D. Lawson
Journal of Experimental Brain Research	Reviewer	Dr. B. D. Lawson
Journal of Vestibular Research	Reviewer	Dr. B. D. Lawson
Military Medicine	Reviewer	Dr. J. S. Crowley

Office of the Secretary of Defense, Phase 1, Small Business Innovation Research Proposals

SD09-H22, Treatment of mTBI Balance Dysfunction via Multimodal Biofeedback	Chief Technical Reviewer	Dr. B. D. Lawson
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Department of the Army
U.S. Army Aeromedical Research Laboratory
Fort Rucker, Alabama, 36362-0577

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U.S. Army Medical Research and Materiel Command